25910/6

JPRS-UMS-86-008

7 AUGUST 1986

USSR Report

MATERIALS SCIENCE AND METALLURGY

19981123 028

DTIC QUALITY INSPECTED 3

FBIS FOREIGN BROADCAST INFORMATION SERVICE

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

JPRS-UMS-86-008

7 AUGUST 1986

USSR REPORT

MATERIALS SCIENCE AND METALLURGY

CONTENTS

COATINGS

COMPOSITE MATERIALS

TREATMENTS

ANALYSIS AND TESTING

NEW VERTICAL METAL SAMPLER

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article "On Different Horizons" under the rubric "Made in the USSR," with the tag line "Selected from material from the Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk, ul. Malysheva, 101 TsNTI"]

[Text] Metal melting requires tracking of a whole set of parameters. However, simultaneous measurement is practically impossible, and results obtained at different times distort the true picture of the process. A vertical probe for metal sampling developed by Urals specialists lacks these defects. It is lowered on a winch into a furnace. When the sampling "port" has reached the required levels, it is opened and a portion of the material is taken. The probe simultaneously measures temperature and gas content in the layer. This method both reduces labor input in measuring and increases measuring accuracy -- the probe makes it possible to obtain essentially new data on the process and, ultimately, to increase furnace efficiency and melt quality. The probe can be used both in metallurgy and in the chemical industry, at construction material industry enterprises.

12809/12955
CSO: 1842/163

MECHANIZED JET FOR NONDESTRUCTIVE INSPECTION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article "Powder Jet" under the rubric "Made in the USSR," with the tag line "Selected from material from the Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk, ul. Malysheva, 101 TsNTI"]

[Text] Defects in metal change the direction of magnetic lines, and, if the surface of an item is sprinkled with magnetized powder, it exhibits an invisible pattern which reveals pits, cavities, and cracks. This widely-used method of nondestructive inspection can be made easier and faster using a portable magnetizer and air "pistol" to spray the powder. Mechanization is particularly effective when defectoscope operators have to check the quality of welds in huge apparatus for the chemical and petrochemical industry.

12809/12955
CSO: 1842/163

UDC 620.179.16

DEPENDENCE OF ULTRASONIC SIGNAL LEVEL DURING INSPECTION OF RAIL STEEL BY ELECTROMAGNETIC-ACOUSTIC METHOD ON MICROSTRUCTURE AND SURFACE CONDITION

Sverdlovsk DEFEKTOSKOPIYA in Russian No 10, Oct 85 (manuscript received 23 Feb 84, in final version 13 May 85) pp 3-7

[Article by L. Ye. Chernyakova, V. K. Ostapchuk, V. I. Skokin, V. I. Gazov and A. D. Khodorovskaya, Ukrainian Scientific Research Institute of Metals, Kharkov]

[Abstract] In an experimental feasibility study, specimens of open-hearth rail steel (0.77% C, 0.86% Mn, 0.023% Si, 0.032% S, 0.017% P) were inspected ultrasonically by the electromagnetic-acoustic method. Measurements were made with UMAR-1 instrumentation, which had been developed at the Scientific Research and Experimental Design Institute for the Automation of Ferrous Metallurgy in Dnepropetrovsk, including a UD-10UA commercially produced defectoscope and an electromagnetic-acoustic converter with a "butterfly" coil having an active area of 15x30 mm^2. Measurements were made by the image-shadow method with shear waves at the ultrasonic frequency of 2.5 MHz, with a 4.5 mm clearance between transducer and steel specimen, and with a magnetic induction of 0.7 T in the air gap. Steel specimens had been heat treated by soaking at various temperatures over the 800-1000°C range for 1 h at each temperature with subsequent furnace, air, or oil cooling. Surface finish and microstructure were determined on the basis of metallographic examination and phase composition was determined on the basis of x-ray microanalysis in a DRON-1 diffractometer with filtered FeK_{α}-radiation. The results reveal that the level of ultrasonic echo signals depends on the microstructure and the surface finish, the magnitude of the signal reflected by the bottom surface being maximum when the top surface is even with a large interlamellar distance in the pearlite phase or is covered with a uniform layer of scale containing principally the Fe_3O_4 oxide. References 3: all Russian.

2415/12955
CSO: 1842/104

UDC 669.15'21'234:538.13

MAGNETIC STATES OF $Fe(Pd_{0.67}Au_{0.33})_3$ ALLOY: INITIAL STAGES OF DISORDERING

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 1 Apr 85) pp 1177-1782

[Article by S. B. Ryabov, Yu. A. Vereshchagin, P. V. Geld, R. A. Sasinova, Yu. P. Denisov and A. A. Kuranov, Ural Polytechnic Institute imeni S. M. Kirov]

[Abstract] An experimental study of the $Fe(Pd_{0.67}Au_{0.33})_3$ alloy and its magnetic states during initial stages of disordering was made, this alloy having an f.c.c. crystal lattice and a composition close to $FePd_2Au$. In the ordered state it forms an $L1_2$-superstructure with four sublattices, two of them occupied preferentially by Fe and Pd atoms and the other two by randomly distributed Pd and Au atoms. Wire specimens 1 mm in diameter were maximally ordered by annealing in a vacuum furnace successively at 1020 K for 2 h, at 970 K for 2 h, at 920 K for 5 h, at 870 K for 10 h, at 820 K for 24 h, at 770 K for 24 h, at 720 K for 48 h, and subsequent furnace cooling. Atomic disordering was then produced in various degrees by loading them in tension successively to 0.5%, 1.0%, 4.0%, 5.0% and 10.0% elongation. Their specific magnetization was measured with a vibromagnetometer in fields of up to 1.6 MA/m intensity at temperatures of 4.2-300 K and their magnetic susceptibility was measured by the Faraday method in fields of up to 1.0 MA/m intensity at temperatures of 78-500 K. An evaluation of the data and an analysis based on the mechanism of moving superstructure dislocation with or without generation and pairwise joining of antiphase boundaries indicate that disordering caused by plastic deformation results in an AF → F transition through intermediate magnetic states with various coexisting magnetic structures superposed on the previously dominant long-range AF order. References 21: 13 Russian, 8 Western.

2415/12955
CSO: 1842/142

UDC 620.186.14:669.14.018.29:669.777

NONMETALLIC INCLUSIONS AND AUSTENITE GRAIN IN STEEL WITH TELLURIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 40-42

[Article by L. V. Popova, A. G. Nasibov, G. G. Guley and G. A. Sveshnikova, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin]

[Abstract] A study of 09G2 steel (0.95% C, 0.95% C, 0.35% Si, 0.05% Al, 0.015% P, 0.014% S) microalloyed with tellurium was made, for the purpose of determining the nonmetallic inclusions and the austenite grain growth. Five ingots of this steel weighing 10 kg each were cast from a 50 kg induction furnace. No tellurium was added to one, for reference, and different amounts of metallic tellurium pellets (0.0032, 0.0035, 0.009, 0.011% Te) were added to the other four during pouring into the ladle. Metallographic analysis confirmed the findings of x-ray mciroanalysis, namely corundum as the principal nonmetallic inclusion with small amounts of Al_2MgO_4, MnS, oxysulfides, and wherever tellurium has been added also round 10-15 μn large includions of Mn_2TeS. These Mn_2TeS inclusions increase the toughness and lessen the anisotropy. The austenite grain growth in that steel with tellurium was monitored under a "Reichert" high-temperature microscope inside a "Vakuterm" heating chamber over the 850-1200°C temperature range, with heating to 900°C done uncer vacuum and heating above that temperature done in an argon atmosphere under a pressure of 30 kPa. The results indicate that tellurium in amounts up to 0.0035% Te does not significantly influence the austenite grain growth, but in amounts of 0.009-0.011% Te enlarges the austenite grain while causing it to begin to grow at 850-950°C already and also tending to lessen the inequigranularity at 950-1150°C. References 6: 3 Russian, 3 Western.

2415/12955
CSO: 1842/137

UDC 546.32'185:54-384

DETECTION OF IMPURITIES IN SOLUTIONS AND SINGLE CRYSTALS OF KH_2PO_4 AND KD_2PO_4 BY ULTRAVIOLET SPECTROSCOPY

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 20 Apr 84) pp 112-114

[Article by V. I. Bredikhin, N. V. Kiseleva and V. V. Korolikhin, Applied Physics Institute, USSR Academy of Sciences]

[Abstract] Studies were conducted on the applicability of ultraviolet spectroscopy in the detection and analysis of Al^{3+}, Fe^{3+} and Cr^{3+} impurities in KH_2PO_4 (KDP) and KD_2PO_4 (DKDP) solutions and single crystals. Graphical analysis of the spectral data demonstrated that in the case of KDP ultraviolet spectroscopy provides both qualitative information on the presence of impurities, and the potential for a quantitative analysis with a sensitivity of ca. 10^{-5} wt% for Fe, 5×10^{-5} wt% for Cr^{3+}, and 10^{-4} wt% for Al^{3+}. On the basis of these findings, ultraviolet spectroscopy has been shown to be a useful technique for monitoring working solutions used in the growing of KDP crystals. References 5: 4 Russian, 1 Western.

12172/12955
CSO: 1842/164

COATINGS

NEW HARD-FACING ELECTRODE

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article "Layer after Layer" under the rubric "Made in the USSR," with the tag line "Selected from material from the Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk, ul. Malysheva, 101 TsNTI"]

[Text] A wise owner does not discard a work part -- these days there are plenty of ways to rehabilitate it and put it to use again. One is to hard-face working surfaces. Engineers in Sverdlovsk propose doing this with a new type of electrode whose wire is coated with a composite of eight elements. One is aluminum, and reactions involving it release a great deal of heat. This means that the welding current can be reduced and the arc will still burn steadily. Hard-faced metal does not crack or crumble. Therefore, layers can be built up until the required thickness is reached. The T-590 and T-620 electrodes now used in industry can build up two layers; the new electrodes (OLN-50), more than five. Hard-faced metal's wear resistance in an abrasive medium is 1.3 to 1.4 times higher.

12809/12955
CSO: 1842/163

UDC 539.23:546.621:620.193.91

PHYSICOCHEMICAL PROPERTIES OF METAL-BASED COATINGS I. ANTI-CORROSION STAINLESS STEEL COATINGS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 6, Nov-Dec 85 (manuscript received 12 May 85) pp 678-682

[Article by V. M. Kadek, D. T. Shkurko, Yu. V. Lipin, V. M. Kozlov, Ye. N. Strebkov and N. A. Kashpur, Inorganic Chemistry Institute, LaSSR Academy of Sciences]

[Abstract] Vacuum methods of coating metals avoid hydrogen brittleness and give good bonding to the base metal while permitting production automation and reducing waste products to a minimum. The present article reports on development of a technology for applying one-sided stainless steel coatings on steel tapes at the Special Design Bureau for Vacuum Coatings under the LaSSR Gosplan working with the Institute of Inorganic Chemistry, LaSSR Academy of Sciences. Coatings were applied by the electron-beam vaporization method using a water-cooled copper crucible. Component balance and rate of application were carefully controlled, and pores in the stainless steel coating were monitored by application of sulfur anhydride, since common methods did not work with stainless steel. Tests showed pore formation in 1-5 hours on uncoated carbon steel, while the stainless steel-coated samples showed pores only after 50-70 days. Electrode potential of the 08KP steel tested confirmed the effectiveness of the test coatings in preventing corrosion. A coating thickness of more than 5 microns is recommended. References 9: 7 Russian, 2 Western.

12131/12955
CSO: 1842/151

EFFECT OF GALVANIC COATING ON MECHANICAL CHARACTERISTICS OF HYDROGENATED STEELS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, Nov-Dec 85 (manuscript received 21 May 84) pp 17-20

[Article by S. N. Rodnikov and T. M. Ovchinnikova, Kirov]

[Abstract] Specimens of SP steel galvanically coated with 60 μm thick chromium layers, without copper strike or with 2 μm, 9 μm, 18 μm copper strikes, and specimens of 60S2A, 65S2VA steels galvanically coated with 9μm thick zinc layers with tested mechanically, for a determination of the effect of such coatings on the mechanical characteristics of those steels and their dependence on the hydrogen content acquired during the coating process. These specimens and, for comparison, specimens without coatings were tested for tensile strength, percentage elongation and reduction, and fatigue strength under symmetric cyclic flexure in terms of maximum bending angle and number of $\pm 15^\circ$ bending cycles till fracture. The test results along with fractographic analysis indicate that the coatings, while not altering the fracture mode, can appreciably influence the mechanical characteristics of steel in any direction. Accordingly, mechanical testing must be done on specimens without coating for a determination of hydrogen embrittlement and on specimens with coating for a determination of performance in service. A comparison of the results will then indicate not only the effect of a coating but also how much of the change in characteristics is due to hydrogen embrittlement. References 9: all Russian.

2415/12955
CSO: 1842/136

DEPENDENCE OF PROPERTIES OF IRRADIATED RESISTIVE FILMS ON PARAMETERS OF DEPOSITION PROCESS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, Nov-Dec 85 (manuscript received 7 Sep 83) pp 30-31

[Article by M. G. Abraizov, Kishinev]

[Abstract] Films of the resistive alloy RS-3710 (37% Cr+ 10% Ni+ 53% Si) were deposited by sputtering with UVN-71P-3 equipment on substrates at a temperature of 250°C and thus far below the melting point of that alloy. One batch was deposited for a period of 140-160 s under a residual pressure of $(8-9)\cdot 10^{-3}$ Pa after admission of air. Another batch was deposited for a period of 40 s under a residual pressure of $(2.5-3)\cdot 10^{-3}$ Pa after admission of air. The starting vacuum was $(1.5-2)\cdot 10^{-3}$ Pa. The process was terminated when the "certification" specimen had been built up to an electrical surface resistivity of 620-660 ohms/□, corresponding to a film thickness of 280-330 Å and 130-170 Å respectively. Some specimens of both batches were annealed in air at 350°C for 2 h, with the electrical resistance of the thinner "pure" specimens not significantly changing and that of the thicker "dirty" specimens appreciably increasing on account of the $CrSi_2$ phase formed in the process. Bombardment of annealed specimens with 4.5 keV air ions to a total dose of $2\cdot 10^{15}$ ions/cm^2 resulted in a decrease of electrical resistance with rising temperature, because of an increasing charge carrier mobility in "pure" specimens and an increasing charge carrier concentration in "dirty" specimens. During subsequent annealing-bombardment cycles the electrical resistance of "dirty" specimens oscillated correspondingly, with an amplitude which eventually dropped to the same level as in the case of "pure" specimens. The results of this study indicate the feasibility of controlling, by means of ion bombardment, the properties of resistive films produced by deposition under a soft vacuum. References 6: all Russian.

2415/12955
CSO: 1842/136

ELECTROSTATIC DEPOSITION OF POLYMER POWDER COATINGS ON FLAT OBJECTS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, Nov-Dec 85
(manuscript received 6 Nov 84) pp 32-39

[Article by L. B. Kotlyarskiy, V. A. Gumenyuk and M. K. Bologa, Kishinev].

[Abstract] Deposition of polymer powder coatings on flat objects, in an electrostatic field, is considered as a combination of processes and analyzed on the basis of applicable physical models. The behavior of an aerosol stream approaching an object and then spreading over its surface is evaluated on the basis of the governing hydrodynamic relations, taking into account the electric fields produced by the sprayer and by the space charges of particles in the aerosol. The physical models of particle sedimentation and induced electric charge buildup on the surface are constructed so as to apply to six most common shapes of flat objects: objects with plane surfaces, objects with shallow recesses, cutouts, or shoulders, objects with deep holes or inside cavities, objects with simple streamlining such as solids of revolution with cross-sections smaller than that of the aerosol stream, simple meshes, multiple meshes or hangers. The deposition process characteristics, namely dependence of its efficiency on the distance from spray nozzle to object surface and on the velocity of the oncoming air stream as well as dependence of its efficiency, of the specific mass deposited, and of the induced electric charge on the process duration are calculated from the balance of aerodynamic and electrostatic forces, taking into account turbulence and assuming a laminar boundary layer. References 13: all Russian.

2415/12955
CSO: 1842/136

UDC 669.15'296:539.213:539.172.3

SHORT-RANGE ORDER IN SPUTTERED Fe-Zr ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 12 Feb 85) pp 1202-1205

[Article by A. A. Kasimovskiy, Institute of Precision Alloys, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin]

[Abstract] The atomic structure of three Fe-Zr alloys (88% Fe+ 12% Zr, 80% Fe+ 20% Zr, 71% Fe+ 29% Zr) produced by sputtering was examined by the method of gamma-resonance spectrometry with recording of electrons. Films of these alloys, approximately 200 nm thick, were deposited on organic substrates. Measurements were made with a standard Mossbauer spectrometer and a gas-filled electron detector at room temperature. An analysis of the data reveals that the gamma-resonance spectrum of each alloy consists of four superposed doublets. Precise equality of intensities I_2 and I_3 as well as closeness of other parameters of states II and III in the superfine structure characterize crystals with two nonequivalent but similar to one another arrangements of iron atoms with equal populations. The data reveal also three different kinds of short-range order, strongly ferromagnetic Fe_2Zr with high Curie point, antiferromagnetic close-packed γ-Fe phase with an f.c.c. crystal lattice or ε-Fe phase with a c.p.h. crystal lattice, both having a low Neel point, as well as a low-symmetry arrangement of iron atoms with large atomic volume. The author thanks R. S. Iskhakov for delivery of specimens. References 11: 1 Russian, 10 Western (1 in Russian translation).

2415/12955
CSO: 1842/142

UDC 669.187.2:621.365.91:537.533:62-419.5

PRODUCING MICROLAYER CONDENSATES ON ELECTRON BEAM APPARATUS USING A COMPUTER

Kiev PROBLEMY SPETSIAL'NOY ELEKTRO-METALLURGII in Russian No 1, Jan 86 (manuscript received 25 May 84) pp 37-41

[Article by G. F. Badilenko, V. P. Mishchenko and Yu. V. Nikolayev, Electric Welding Institute imeni Ye. O. Paton, UkSSR Academy of Sciences]

[Abstract] Early microlayer composites (MLC) were produced by mechanical means. Later improvements focused on thermomechanical processing of powder mixtures, or on casting followed by rolling. Precipitation methods have also been used. The present article reports on studies at the Paton Institute of electron beam vaporization followed by condensation in a vacuum. Metal-metal, metal-carbide, metal-oxide and carbide-oxide variants have been tested. Where three components are desired, a 3-crucible system is employed. The apparatus used is diagrammed and it and the process are described. The UTK-4 control system containing a microcomputer which is used can be adapted using various programs to produce a wide variety of microlayer composites, both in the form of coatings on substrates of various configuration and in the form of finished parts and semimanufactured products. References 10: all Russian.

12131/12955
CSO: 1842/152

UDC 539.23:546.289'171.1

CHEMICAL STABILITY OF GERMANIUM OXYNITRIDE FILMS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 19 Apr 83) pp 80-83

[Article by S. Ye. Aleksandrov, V. A. Kryakin, F. F. Grekov and A. M. Zykov, Leningrad Polytechnical Institute imeni M. I. Kalinin]

[Abstract] The demonstration that amorphous films obtained from solid Ge_3N_4-GeO_2 function as low-temperature insulating coatings led to evaluation of the chemical stability of germanium oxynitride films. The latter were formed from $GeCl_4$-NH_3-H_2O (I) and $GeBr_4$-NH_3-H_2O (II) systems at 720-1025 K, yielding solid tetrahedra with the GeO_xN_{4-x} formula, with $0 < x < 4$ and with Ge-N and G-O bonds proportional to $N/(N + O)$ and $O/(N + O)$. Solubility studies in 46% HF, 1 N NaOH, 1 N H_2SO_4 and water demonstrated that the chemical stability of the films decreases with an increase in the oxygen content, but that thermal stability increases. The presence of residual halogen products in films prepared from I and II mixtures was seen to diminish chemical stability several fold. Films with high oxygen content ($0.7 < N/(N + O) < 0.3$) tolerated temperatures of 1020 K for 5 h. References 7: all Russian.

12172/12955
CSO: 1842/164

COMPOSITE MATERIALS

ELECTROCHEMICAL DISSOLUTION OF FIBROUS COMPOSITE MATERIAL ON METAL BASE

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 6, Nov-Dec 85 (manuscript received 28 Jun 84) pp 5-8

[Article by A. D. Davydov, A. N. Malofeyeva, N. A. Daniltseva and V. D. Kashcheyev, Moscow]

[Abstract] Anodic dissolution of a composite material consisting of tungsten-alloy fibers in a chromium-alloy matrix was studied in an experiment, for the purpose of establishing the optimum parameters of its electrochemical treatment. Aqueous solutions of NaOH, Na_2CO_3, $NaNO_3$, and their mixtures were used as electrolytes, NaOH and Na_2CO_3 for dissolution of tungsten and $NaNO_3$ for dissolution of chromium. Potentiodynamic curves were plotted at the rate of 0.24 V/min, with disk electrodes of pure tungsten, of pure chromium, and of the composite material respectively, stationary or rotating at 3800 rpm. The results indicate that electrochemical treatment of the composite material requires a sufficiently alkalinic electrolyte in which both chromium and tungsten are soluble so that they will dissolve simultaneously at an anode potential within the steep range of the current-voltage characteristic at current densities corresponding to equal linear dissolution rates for both metals. References 6: all Russian.

2415/12955
CSO: 1842/136

UDC 669.715:620.193:539.4

EFFECT OF CORROSIVE MEDIUM ON CRACKING RESISTANCE OF ALUMINUM-BORON COMPOSITE MATERIAL

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 16 Apr 85) pp 43-46

[Article by G. G. Maksimovich, A. V. Filipovskiy, M. E. Chaplya, V. I. Mikheyev and N. M. Gvozdyuk, Physical Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, Lvov]

[Abstract] A study of the composite material consisting of 65 vol.% M40 aluminum alloy as matrix and 35 vol.% boron fibers 140 μm in diameter as reinforcement was made, for a determination of its cracking resistance in a corrosive medium such as 3% aqueous NaCl solution and of the role played by the brittle transition zone at the matrix-fiber interface. The material was produced by hot rolling of ribbon stacks with a straight parallel lay of fibers in the direction of fiber orientation. Rectangular specimens with edges parallel and perpendicular to the fibers were annealed at 550°C for 1,2,5 h in an atmosphere of pure argon, which resulted in formation of brittle transition zones of a depth increasing with the length of annealing time. Some specimens were tested for tensile strength. Here annealing for 1 h had no significant effect, but annealing for longer periods of time had resulted in weakening under a load in the direction of fibers. Microstructural examination and phase analysis after fracture, with the lateral surfaces of fibers etched in 50% aqueous HCl solution, revealed a transition zone consisting of the AlB_2 compound. This compound was to lower the cracking resistance as well. Specimens for the cracking test in the 3-point flexure mode had been pre-notched either along or across fibers and then soaked with unprotected edges in 3% aqueous NaCl solution for 100,1000 and 10000 h before being loaded in a UME-10TM machine with the movable clamp sliding at a speed of 0.5 mm/min. Fracture of these specimens was found to be brittle with the notch across fibers and quasi-brittle with the notch along fibers. Soaking for up to 1000 h increased the cracking resistance across fibers and did not change the cracking resistance along fibers, but soaking longer up to 10,000 h decreased the cracking resistance in both directions. References 4: 3 Russian, 1 Western.

2415/12955
CSO: 1842/141

UDC 666.98+546.185

EFFECTS OF GRAPHITE FIBERS ON SOLIDIFICATION OF COPPER-PHOSPHATE BINDERS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 24 Jan 84) pp 139-144

[Article by N. Kh. Belous, V. V. Samuskevich and I. N. Yermolenko, General and Inorganic Chemistry Institute, Belorussian SSR Academy of Sciences]

[Abstract] X-ray and microphotography were employed in an analysis on the on the effects of graphite and phosphorus-graphite fibers on the solidification of copper-phosphate binders and the composition of the resultant products. The composites were prepared by mechanical mixing of copper(II) oxide and graphite fiber (3:1) with 75% phosphoric acid with $CuO:P_2O_5$ = 4:1 (as used for the copper-phosphate binder). The 15-20 μm diameter fibers were comminuted to 150-200 μm in length. The graphite fibers were seen to significantly prolong the solidification times due to absorption of the phosphoric acid solution and, hence, alteration in the ratios of the reactants, i.e., copper oxide and phosphoric acid. Concomitantly, the composition of the products in terms of the individual components (H_3PO_4, $Cu(H_2PO_4)_2$, $CuHPO_4$, $Cu_3(PO_4)_2$) changed, with H_3PO_4 diminishing and disappearing with the time of solidification, and $Cu_3(PO_4)_2$ appearing and increasing. Thus, while providing reinforcement and imparting electrical conductivity to such binders and their products, the graphite fibers also alter their composition and crystallinity. References 7: 6 Russian, 1 Western.

12172/12955
CSO: 1842/164

INORGANIC ADDITIVES FOR CORROSION-PROTECTION COATINGS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article under the rubric "Science and Technology News": "Acid against Acid"]

[Text] Acid is the enemy of metal. But couldn't it be converted into an ally? This was the goal of the scientists at the All-Union Interindustry Scientific Research Institute for the Protection of Metals from Corrosion. They supplemented formulas for series-produced anti-corrosion compositions with special inorganic additives which not only withstood, but actively reacted with strong acids. As a result, the "coating-additive" system, as it were, casehardens its own structure, reliably insulating the metal from contact with aggressive liquids. The service life of the series-produced coatings rose five- to six-fold and strength increased 15-20%.

12809/12955
CSO: 1842/163

UDC 621.762

ANTI-CORROSION PROTECTION OF POWDER METALLURGY PRODUCTS IN INSTRUMENT MAKING

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 11, Nov 85 pp 35-37

[Article by I. S. Litmanovich, candidate of technical sciences and Ya. M. Zolotovitskiy, candidate of chemical sciences]

[Abstract] The increased tendency towards corrosion in powder metallurgy products comes from high residual porosity which causes difficulties in developing effective anit-corrosion procedures. In particular, when applying electrochemical coating to powder products, one has to additionally subject them to various treatments to protect the surfaces and pores from the action of electrolytes and other corrosive solutions. In instrument making the water-proofing method recommended by the Institute of Materials Science Problems, UkSSR Academy of Sciences, is most widely used. Powder products are soaked in a 10% solution of a waterproofing silicone liquid in benzene, tricklor-oethylene or perchlorocthylene which polymerizes after heat treatment at 140-160°C for an hour and forms a water-repellent film. Careful observation of the technological processes of water-proofing especially heat treatment, will yield electro-coatings whose corrosion resistance satisfies the requirements for the use of instruments in a temperate climate. However, the film may not totally prevent the penetration of corrosive liquids into the pores. In examinating methods for the anti-corrosion protection of powder metal products, the latter should be divided into two groups: products without any special decorated requirements and products whose protective coatings should also perform decorative functions. For the first group the use of inhibiting impregnating compositions without the application of electro-coatings is promising. The task is to develop inpregnating inhibiting compositions based on mineral oils which would be as effective as electro-coatings and could be used under any climatic conditions. For the second group improvement of the technology for applying electro-coatings is urgent. One cannot do without them if they also perform decorative functions. The use of waterproofing silicone liquids should be discontinued and be replaced by unpregnating compositions which ensure complete sealing of pores and not simply the water-proofing of surfaces. The use of anaerobic sealants is promising. For powder products that are subject to further working by cutting anaerobic sealants are not enough. The most radical method of increasing the corrosion resistance of powder metal products, including those subject to cutting, can be their compaction to a porosity of not more than 3% by cold or hot plastic working. With such a porosity a compact material is essentially produced and all specific problems of anti-corrosion protection for powder products are removed.

12131/12955
CSO: 1842/157

UDC 620.193:620.194:620.197

CORROSION BEHAVIOR OF AUSTENITIC STEELS 06Cr18Mn9Ni5AB AND 07Cr13AMn20

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 3 Jul 85) pp 46-51

[Article by G. V. Fenik, V. N. Pavlov, I. I. Vasilenko, R. K. Melekhov and V. P. Loginov, Physical and Mechanical Institute imeni G. V. Karpenko, UkSSR Academy of Sciences, Lvov]

[Abstract] Two austenitic steels, chromium-manganese-nickel steel 06Cr18Mn9Ni5AB (<0.06% C, 17-19% Cr, 8-10% Mn, 4-5.5% Ni, 0.2-0.5% Nb, <0.6% Si, 0.02% S, 0.02% P) and chromium-manganese steel 07Cr13AMn20 (<0.07% C, 12-14.8% Cr, 19-22% Mn, <1.0% Ni, 0.935% P, 0.025% S), were tested for corrosion cracking and pitting under slowly increasing tension in 42% $MgCl_2$ solution at 100-154°C, in 0.5% NaCl solution at 98°C, and in 30% NaOH solution at 100°C. For reference in a comparative evaluation, chromium-nickel steel 12Cr18Ni10Ti (0.11% C, 18.9% Cr, 11.1% Ni, 0.62% Ti, 1.08% Mn, 0.3% Cu, 0.64% Si, 0.028% P, 0.008% S) was also tested under the same conditions. Specimens of each steel had been austenitized in air at 1050°C (06Cr18Mn8Ni5AB), 980°C (07Cr13AMn20), and 1080°C (12Cr18Ni10Ti). The corrosion potential was measured and polarization curves, potentiodynamic ones as well as quasi-potentiodynamic ones as well as quasi-potentiostatic ones, were plotted under a static load with strain rates of 10^{-6}-10^{-5} s^{-1} corresponding to plastic deformation at the tip of a crack in these steels. The results of this study indicate the range of stable passivation and the range of strain rate within which scarce nickel may be replaced with manganese as an economy measure. References 7: 5 Russian, 2 Western.

2415/12955
CSO: 1842/141

UDC 620.193.41:669.295

CORROSION RESISTANCE OF AT3 TITANIUM ALLOY IN DILUTE H_2SO_4 SOLUTIONS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 26 Apr 85) pp 83-84

[Article by V. Ye. Blashchuk, L. I. Onopriyenko and M. V. Chervonyy, Kalush Khlorvinil Production Association]

[Abstract] An experimental study of the AT3 titanium alloy (3.5% Al, 0.6% Cr, 0.5% Fe, 0.4% Si, 0.06% Mo, 0.3% Zr, 0.06 wt.% O_2, 0.011 wt.% N_2, 0.0015 wt.% H_2) was made, for the purpose of determining its corrosion resistance in 0.6-5% H_2SO_4 solutions over the 293-453 K temperature range. Ingots of this alloy were heat treated in a gas furnace: heating to within 823-863 K at a rate of 100 K/h + holding at that temperature for 4 h + furnace cooling to 573 K + cooling in still air to room temperature. This treatment increased the amount of gaseous inclusions only slightly to 0.08 wt.% O_2, 0.012 wt.% N_2, 0.002 wt.% H_2. General surface corrosion was measured on 5 mm thick and 25x10 mm^2 large specimens in glass retorts with inverted coolers at 298 K (5000 h), 323 K (200 h), 373 K (100 h) and in special autoclaves with teflon inserts at 403 K (400 h), 453 K (400 h). The corrosion rate at 298 K was found to vary from 0.5 μm/year in 0.6% H_2SO_4 to 2 μm/year in 5% H_2SO_4, the corrosion resistance thus remaining high at all temperatures in up to 0.9% H_2SO_4 solutions. Both corrosion rate and hydrogenation rate increased appreciably as the H_2SO_4 concentration was increased beyond 0.9%. Both corrosion rate and hydrogenation rate increased with the temperature to a maximum at the boiling point, then decreased and stabilized at temperatures above the boiling point. References 3: all Russian.

2415/12955
CSO: 1842/141

UDC 621.791.08:620.198

STRESS CORROSION OF 'STEEL + ALUMINUM COATING' COMPOSITES

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 22 Aug 84) pp 84-85

[Article by V. N. Polyakov, L. K. Gordiyenko, V. P. Karshin, V. V. Nezhdanov, M. N. Lobashev, Yu. K. Krasnov and B. F. Shibryayev, Scientific-Production Association, State All-Union Scientific Research Institute of Tractors, Moscow]

[Abstract] Aluminum plasma coatings and powder coatings on 40Kh steel were tested for stress corrosion in a 1200 mg/liter aqueous H_2S solution pure (pH 4.1) and with 3% NaCl. The specimens were cylindrical and notched at the center with a 0.4 mm rounding radius at the bottom of the notch in the steel cylinder. In pure H_2S solution bare steel fractured fast, within 1 to 100 h depending on the load level, but powder coatings did not corrode and the steel underneath did not fracture at all within at least 1100 h. Addition of 3% NaCl resulted in pitting of powder coatings and fracture of the steel underneath under any load or without load. Plasma coatings corroded only under stress in pure H_2S solution and the life of the steel underneath was not shortened by addition of 3% NaCl. References 2: both Russian.

2415/12955
CSO: 1842/141

FERROUS METALS

LIPETSK MAGNITKA STEEL

Moscow TRUD in Russian 5 Feb 1986 p 1

[Article by Trud correspondent V. Gorodetskiy, datelined Lipetsk, under the rubric "Report from the Leading Edge"; passages in slantlines printed in boldface]

[Text] /The Novolipetskiy Metallurgical Combine is completing installation of a one-of-a-kind rolling complex./

The vaulted area 16 hectares in size resembles a high stadium. From a distance, large KamAZ trucks crawling along the bays look like matchboxes. Only the 4-high "1400" mill towers majestically -- it is the reason for the creation of this rolling complex, which has no comparison either in this country or abroad.

Both the complex and the products to be produced here are unique. Use of qualitatively new Lipetsk dynamo steel will substantially raise energy yield of power station generators.

I am standing in the midst of a bay in which process equipment is being installed. A. Gubanov, chief of staff of the construction site is speaking:

"This is the pre-startup stage. According to standards, 42 months were allocated for the first stage. The builders and installers decided to shorten this period by a year. The first metal will pass through the skin mill on the eve of the 27th CPSU Congress."

People are virtually invisible under the complex's vaults. Somewhere the flame of an electric welder flickers; just-installed bridge cranes rumble overhead. Whereas up to 20,000 men were involved in the pre-startup period at previous Novolipetsk Combine construction sites, now the number of workers is considerably lower. It's not just that the skills of the Lipetsk Magnitka builders have increased over the past two five-year plans. The system for organizing work is different.

In contrast to the previous construction sites, this time everything began with erection of the support facilities -- a four-story administrative-services building. People didn't have to be sheltered in trailers or temporary buildings.

Working conditions became better, labor productivity improved. But most important, an assembly line method was introduced. It is based on prefabricated slab construction. For example, a roof is assembled on special stands and then set in place in whole 800 m^2 slabs. Two high-power cranes raise a substantial section fitted with trusses and piping in one operation. Even bridge cranes, which number about 40 in the main building, are assembled on the ground.

There is another powerful lever for high-speed construction -- the integral process brigade assembly line contract. A. Paton's team from Stalkonstruktsiya introduced it. The team took on the job of erecting the metalwork for the shell of the main building, and Hero of Socialist Labor I. Makarov and his comrades from the Lipetskstroy Trust's SU [Construction Administration] -9 decided to construct the foundations under the rolling mill as one piece.

When I. Makarov signed the acceptance certificate for the project 6 months ahead of schedule, a team under another Hero of Socialist Labor, B. Grigoryev, from the Lipetsk Metallurgprokatmontazh administration, took over where he left off. It has to complete installation of the rolling mill's process equipment ahead of schedule, by the opening of the Party Congress.

This deadline has become the reference point for the entire project.

12809/12955
CSO: 1842/163

UDC 669.15'26'74-194:620.186.1

CARBON CONTENT IN MARTENSITE OF FERRITIC-MARTENSITIC STEELS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 23 Jan 85) pp 1223-1225

[Article by T. V. Yegorshina, A. A. Petrunenkov and N. M. Fonshteyn, Institute of High-Grade Steels, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin; Scientific Research Institute of Tractor and Agricultural Machine-Building Technology]

[Abstract] The carbon content in the martensite phase of low-alloy ferritic-martensitic steels was determined on the basis of direct x-ray structural analysis in a DRON-3 diffractometer with an MoKβ_1- radiation source, the low carbon content being responsible for the absence of visible splitting of the martensite doublet. Such a determination required a harmonic analysis of the spectral lines and subsequent minimization of the sum of differences between Fourier coefficients and their representations in terms of unknown Fourier-singlet coefficients squared. The appropriate algorithm was used according to a modification of the "Spektr" program allowing separation of triplets, assuming symmetry and similitude of their component singlets. The procedure was applied 10 times to each spectral line, each time with different initial conditions in terms of coordinates of the singlet centers. The differences were found to be statistically insignificant and the results were found to be adequate, according to the Fisher criterion. The results thus obtained for variously heat treated steels 06KhGSR (water quenched from 760°C or 820°C to air, or from 760°C to liquid nitrogen), 20KhGSR (water quenched from 760°C or 820°C to air), 09G2 (air cooled from 820°C under b blower) have yielded a carbon content not exceeding 0.3% after any heat treatment. References 7: 5 Russian, 2 Western.

2415/12955
CSO: 1842/142

MILL FOR HARD TO FUSE METALS DEVELOPED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Jan 86 p 4

[Article by Ye. Tkachenko: "Step Beyond the Barrier of What is Customary"]

[Text] When we hear the word tungsten an electric light bulb usually comes to mind, but we hardly ever think how the slender threads which carry light into our homes are obtained from this extremely tough metal. On the other hand, specialists know well just how painstaking, labor-intensive, costly and harmful to the health this process is.

The technology, which was developed back at the start of this century and includes ordinary manual forging on rotary machines, is virtually unchanged to this day. And, alas, the workers are required to deal with vibrating equipment and metal heated to 1500 degrees Centigrade. This is the minimum temperature at which tungsten begins to deform.

The shortcomings of this method have long been known, and the fact that it has not changed for decades is not so much the fault of engineers as it is their misfortune. All attempts by developers to get away from the accustomed technology were unsuccessful. The prospects for rolling tungsten were particularly attractive. You see, rolling can be automated, the shape of the metal can be controlled and at times even its quality can be improved.

Many have tried to pass a tungsten rod through a mill's rollers. And they obtained powder and misshapen fragments. The same thing occurred with molybdenum, nickel, chrome and super strength steel alloys made from these metals. The opinion took root among specialists that these metals were not for rolling.

Scientists from the Chelyabinsk Polytechnical Institute were able to refute this opinion. They developed a fundamentally new method of rolling and special mills for obtaining solid rolled and jobbing shapes and wires made out of hard to fuse and hard to deform metals.

And it is no accident that the invention originated at the rolling faculty. In recent years the employees there have created numerous modern processes, which substantially improve product quality, raise productivity and ease the working conditions of metalworkers.

"At first glance the solution seemed amazingly simple," states Professor V. Vydrin, doctor of engineering and faculty chief. "We proposed compressing the rod not from two sides, as usual, but from four. This forced the metal to flow only to one direction that where its size is reduced. The idea turned out to be fruitful and we began to vary the force and speed of rotation of the rollers and found the parameters at which the metal stopped being destroyed. Moreover, in the experiments we sometimes took billets known to be defective and obtained rolled products without defects. The process turned out to be capable of `healing' internal defects and improving the characteristics of the metal."

The Chelyabinsk technology has been introduced in Uzbekistan at the Chirchik combine for hard to fuse and heat resistant metal. A single line consisting of four rolling stands replaced a large section of rotary forging machines and freed numerous people from harmful work. The innovation increased labor productivity there 1.5 fold. Currently the Chelyabinsk technology is being introduced in enterprises in Moscow, Saratov and Ordzhonikidze. According to the calculations of manufacturers it will save thousands of rubles on each ton of machined products.

"It would seem that there is something to be glad about," continues V. Vydrin. "But... 10 years passed from the beginning of research until the first industrial mill was commissioned in Chirchik. By past measures this may be bad. Now, when the economy is shifting to intensive technologies, the introduction of innovation should be accomplished much more energetically and widely. The draft Basic Directions of Economic and Social Development of the USSR speaks directly about the need to increase the durability of construction materials. This will make it possible to increase the service life and the reliability of goods. This means that metallurgists must solve tasks associated with machining ever tougher alloys. We are prepared to help them. New generation mills have already been developed. No more than three years should pass from the beginning of design until they are introduced."

9069
CSO: 1842/130

UDC 669.784:669.85/.86:539.219.3

DIFFUSION OF CARBON IN RARE-EARTH METALS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 14 Feb 85) pp 1206-1211

[Article by Ye. V. Deshkevich, R. M. Dubovtsev and V. S. Zotov]

[Abstract] Diffusion of carbon in erbium was measured over the 700-1200°C temperature range, using specimens of ErM-1 erbium with a total impurity content not exceeding 0.1% of all other rare-earth metals and operating with a "momentary diffusion" source. A theoretical evaluation of the data on the diffusion coefficient $D_0 = Ae^{Q/B}$ and the diffusion activation energy Q for carbon as well as for other impurities (C, O_2, N_2, H_2, other rare-earth metals) in erbium, combined with already available data on diffusion and self-diffusion in "lighter" rare-earth metals (La, Ce, Pr, Sm, Eu, Gd, Ho), presents a more complete picture about diffusion of interstitial impurity elements as a group in rare-earth metals as a group. References 31: 12 Russian, 19 Western (1 in Russian translation).

2415/12955
CSO: 1842/142

UDC 669.5'73:539.376:53.096

DEPENDENCE OF HIGH-TEMPERATURE CREEP ACTIVATION ENERGY FOR CADMIUM, ZINC, Cd-Zn ALLOYS, AND Zn-Al ALLOYS ON GRAIN SIZE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 5 Dec 84) pp 1212-1216

[Article by G. V. Vladimirova, P. Lukach and G. A. Malygin, Physical Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences]

[Abstract] The dependence of the creep activation energy for Cd-Zn and Zn-Al alloys on the grain size was measured over the temperature range of (0.4-0.8)T_{melt}. Specimens of Cd+ 0.6% Zn, Cd+ 6% Zn, and Zn+ 1.1% Al were segragated into three groups each: 1) fine-grain specimens (1-50 μm), 2) medium-grain specimens (400-600 μm), 3) coarse-grain specimens (1.5-2 mm). For reference, also fine-grain and coarse-grain specimens of 99.95% pure cadmium and 99.999% pure zinc were included. They were tested for creep in torsion, with their temperature rising at a constant rate of 2.5-3 K/min to a total temperature rise of 30-60 K from start to end of the deformation process. The results indicate different deformation mechanisms during high-temperature creep in these metals and alloys with a c.p.h. crystal lattice, depending on the grain size, namely grain-boundary deformation in fine-grain structures and intragranular diffusion with dislocation climb at lower temperatures or prismatic glide at higher temperatures in medium-grain and coarse-grain structures throughout the 10^{-7}-10^{-4} s^{-1} range of strain rates. Transition from dislocation climb to prismatic glide occurs at temperatures above 0.6%$_{melt}$. References 15: 3 Russian, 2 Western.

2415/12955
CSO: 1842/142

UDC 669.5'71:539.374:620.187.3

STUDY OF INTRAGRANULAR DEFORMATION IN SUPERPLASTIC ALLOY Zn+ 22% Al BY REPLICA LOCATING METHOD

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 4 Mar 85) pp 1217-1222

[Article by R. Z. Valiyev, S. N. Dudina and I. S. Obraztsova, Ufa Aviation Institute imeni Sergo Ordzhonikidze]

[Abstract] The recently developed method of replica locating electron-microscopy was expediently used for a study of intragranular deformation in the typical superplastic alloy Zn+ 22% Al with ultra-fine-grain (0.3-5 μm) structure. Specimens of this alloy were produced with an equiaxial structure and 0.3-0.5 μm mean grain size. After buildup of grains to 1 μm size by annealing at 523 K for 40 min and subsequent water quenching, for better targeting under an electron microscope, the surface of specimens was electrolytically polished and etched with 10% HClO solution in ethyl alcohol at 60 V and 200 K so as to reveal α -phase and β-phase grains. These specimens were put under tension in an Instron universal dynamometer and loaded to 24%, 35%, 55% elongation at 523 K at a rate of 5 mm/min, thus under the optimum conditions for attainment of superplasticity in the given alloy. An analysis of markers movement on replicas has revealed that intragranular strain produced by dislocation movement in both phases during superplastic flow is a nonuniform oscillatory function of the total strain. As the total strain becomes large, grains tend to remain equiaxial and the relative contribution of intragranular strain to the total strain becomes small. References 14: 9 Russian, 5 Western.

2415/12955
CSO: 1842/142

UDC 620.17:620.18:669.295.5

DEPENDENCE OF MECHANICAL PROPERTIES OF VT3-1 TITANIUM ALLOY ON MORPHOLOGY OF BREAKUP PRODUCTS OF METASTABLE PHASES FORMING FROM HIGH-TEMPERATURE β-PHASE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 48-50

[Article by A. S. Fedotov, A. M. Nemanov and A. Yu. Sokolova, All-Union Scientific Research Institute of Aircraft Materials and Perm Polytechnic Institute]

[Abstract] A study of the VT3-1 martensitic (α +β)-phase titanium alloy was made, for the purpose of explaining the nonmonotonic dependence of some mechanical properties such as ductility and toughness on the first stage of its 2-stage heat treatment. Rolled rods, rolled plates, and punched plates were annealed first at 920°C for 30-60-90 min and then, after air cooling to room temperature, at 550°C for 2 h before final air cooling. The results of microstructural examination indicate that this nonmonotonic dependence of both properties on the duration of the first annealing stage, with ductility and toughness each passing through a minimum, relates not to the monotonic changes in ratio and composition of the high-temperature phases following the α → β-phase transformation at 920°C but to the kinetics and the mechanism of breakup of the metastable β-phase in the presence of α "-martensite prone to reverse martensite transformation. References 5: 4 Russian, 1 Western (in Russian translation).

2415/12955
CSO: 1842/137

UDC 620.17:621.785.3:669.295.5

DEPENDENCE OF MECHANICAL PROPERTIES OF SEMIPRODUCTS OF VT20 and VT6 TITANIUM ALLOYS ON ANNEALING TEMPERATURE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 50-52

[Article by Ye. A. Borisova, N. I. Kirichenko and M. I. Yermolova, All-Union Scientific Research Institute of Aircraft Materials]

[Abstract] A study of semiproducts of VT20 and VT6 titanium alloys was made, for the purpose of determining the dependence of their mechanical properties on the annealing temperature. Rods 12 mm in diameter of both alloys and 40 mm thick plates of the VT20 alloy were annealed at various temperatures over the 500-900°C range with subsequent air cooling. In the case of the VT20 pseudo-α -phase alloy the results of mechanical tests revealed a 60-65% dip of toughness and a 15% reduction without significant change in percentage elongation after annealing at 550-700°C. In the case of the VT6 (α +β)-phase alloy the results of mechanical tests revealed a monotonic decrease of toughness without significant changes in plasticity following an increase of the annealing temperature over the entire range. Rods and plates of the VT20 alloy were also tested in impact flexure, after hot deformation (maximum toughness: 0.45 MJ/m^2) and after subsequent annealing at 650°C (minimum toughness: 0.2 MJ/m^2). Fractographic analysis under a "Quickscan" microscope with x1000 magnification revealed lamellar hybrid brittle-ductile segments with pits. Phase analysis under a transmission electron microscope by the microdiffraction method revealed breakup products of the metastable β-phase and no α 2-phase, except its long-range order reflex. This alloy, containing over 6% Al and over 2% Zr, should preferable be annealed at 800-900°C. Fractographic analysis was performed by N. V. Guk. Microdiffraction analysis was performed by A. Yu. Sokolova.

2415/12955
CSO: 1842/137

UDC 669.295.3:620.192.5

VOLUMETRIC CHANGES IN ($\alpha + \beta$) TITANIUM ALLOYS DURING POLYMORPHIC TRANSFORMATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 52-56

[Article by A. A. Ilin, M. Yu. Kollerov, V. V. Zasypkin and V. M. Maystrov, Aviation Technological Institute imeni K. E. Tsiolkovskiy, Moscow]

[Abstract] Polymorphic $\beta \rightleftharpoons (\alpha + \beta)$ transformation in titanium alloys is analyzed for volume effect, such a transformation occurring over a wide temperature range and with attendant changes in phase composition. As an $(\alpha + \beta)$-phase alloy is cooled from the β-phase range down to the Ar_3 temperature, at which $\beta \rightleftharpoons (\alpha + \beta)$ transformation begins, an α-phase containing less β-stabilizer than the original β-phase is formed and the difference between the elemental contents of the two phases increases continuously. A volumetric analysis of this process is performed on the basis of the schematic titanium/β- stabilizer constitution diagram. This model is used for calculating the atomic volumes of both α-phase and β-phase as well as the volume effect or relative difference between the two atomic volumes, as function of the temperature, also the dependence of those two atomic volumes at temperatures Ac_3- 20°C and Ac_3+ 20°C as well as of the minimum volume effect on the weight fraction of β-stabilizer. Numerical results based on this general model and on experimental data are shown for several titanium alloys: Ti+ 16 wt.% V, VT14, VT20, VT22, VT23, VT30, and TS6. They suggest that formation of a lamellar structure in these alloys during slow cooling from the β-phase range is facilitated not only by the favorable mutual orientation of α-phase and β-phase crystal lattices but also by the large volume effect of that transformation with attendant inevitable proneness of the new phase to nucleation in lamellar form. References 7: 5 Russian, 2 Western (both in Russian translation).

2415/12955
CSO: 1842/137

UDC 669.721.661

IMPROVEMENTS IN MAGNESIUM ELECTROLYZER WITH LATERALLY INSERTED ANODES

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 51-54

[Article by P. A. Donskikh]

[Abstract] A description is provided of the design and operation of an electrolyzer for magnesium purification that employs laterally inserted electrodes, the iron housing of which is protected by graphite plates. The start-up time for the electrolyzer is about one month. With an anodal current density of 0.36 A/cm^2 and a cathodal density of 0.47 A/cm^2 the magnesium yield is 1.7% in terms of current with low potential (0.2 V). The housing is designed to accommodate an electrolyzer with ca. 20% higher voltage line and provide a direct current energy expenditure of <15.0 kW·h/kg of magnesium. Chlorination of MgO appears to involve preferentially the horizontal surface of the graphite anodes by the chlorine released from those surfaces. References 4: all Russian.

12172/12955
CSO: 1842/146

UDC 669.777:621.315.59

OPTIMIZATION OF ZONAL PURIFICATION OF TELLURIUM IN HYDROGEN STREAM

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 54-55

[Article by O. N. Kalashnik, V. R. Petrenko and V. A. Terban]

[Abstract] Statistical analysis was applied to zonal purification of tellurium under a stream of hydrogen in order to optimize the process. The essential approach utilized experiment planning theory and nonlinear programming, concentrating on the following three technical factors: the number of runs, length of the melt zone, and rate of translation of the melt zone. Evaluation of the recovery of tellurium and the concentration of admixtures in the final ingot led to the definition of optimal operating parameters which resulted in an operating time of 115.14 h, with a 60.0% yield of tellurium with 6.58×10^{-3}% impurities. References 7: all Russian.

12172/12955
CSO: 1842/146

UDC 669.187.2:621.9.025.7:669.018.95

MECHANICAL PROPERTIES OF TITANIUM CARBIDE CONDENSATES WITH METALLIC BINDER

Kiev PROBLEMY SPETSIAL'NOY ELEKTROMETALLURGII in Russian No 1, Jan 86 (manuscript received 10 Feb 84) pp 34-37

[Article by G. F. Badilenko, A. V. Demchishin and A. Ye Kushnirenko, Electrical Welding Institute imeni Ye. O. Paton, UkSSR Academy of Sciences]

[Abstract] The article reports on a study of titanium carbide condensates containing up to 20% metallic binders of chromium, nickel, cobalt and their alloys. The test condensates were deposited on 1 mm niobium sheet, with vaporization in a vacuum chamber. Details of the deposition procedure are summarized. Test specimens of titanium carbide were formed into small bars of 45-47 mm in diameter, then sintered at 2200°C in a hydrogen medium for 1.5 hours. The composition of condensate substrate was determined by chemical analysis and structure by X-ray diffraction. Results indicated that introduction of cobalt into TiC increased the ductility of the specimens. Low temperature (600-800°C) condensates contained free titanium, carbon and the TiC phase, in a crystalline structure. With increase of temperature to 1300°C, the structure became more homogeneous. Microhardness, density and bending strength studies indicated that the metallic binder's composition had little impact on these properties until its total content reached 20%; rather, only the gross metal quantity was a determinant. The data obtained indicated that the density and mechanical properties of TiC condensates can be regulated over a broad range by the introduction of metallic binders. References 2: both Russian.

12131/12955
CSO: 1842/152

UDC 548.522+546.815'22'24

CRYSTAL GROWTH FROM VAPOR PHASE AND HOMOGENEITY BOUNDARIES OF SOLID $Pb_{1-y}(S_xTe_{1-x})_y$ SOLUTION

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 7 May 84) pp 33-35

[Article by V. N. Demin, I. G. Bukreyeva, A. M. Gaskov, V. P. Zlomanov and A. V. Novoselova, Moscow State University imeni M. V. Lomonosov]

[Abstract] Conditions for the growth of crystals from the vapor phase in quartz ampules are described and the homogeneity boundaries of solid $Pb_{1-y}(S_{0.05}Te_{0.95})_y$ solutions determined, with the solid solution formed from a lead-sulfur-tellurium system and the crystals from the vapor-liquid-crystal system. Analysis of the data on the changes in the mole fraction of lead sulfide, the parameters of the crystalline lattice, and the concentration of carriers along the length of the crystal indicated that the initial (ca. 1 cm) section of the crystal is most homogenous in terms of composition and galvanomagnetic properties. In the terminal portion the concentration of vacancies shows an increase. Molar fraction of lead sulfide was a length-dependent parameter which, however, remained close to the value in the starting charge. The sulfur concentration in the terminal part of the crystal increases, apparently due to a variation in the composition and temperature of the melt at the front of crystallization. A phase diagram is provided for the homogeneity boundaries of the solid solution with p- and n-type conduction. References 8: 2 Russian, 6 Western.

12172/12955
CSO: 1842/164

UDC 537.311.33

THERMOELECTRIC CHARACTERISTICS OF SEMICONDUCTOR $Bi_2Te_{2.4}Se_{0.6}$ (I) AND $Bi_{0.52}Sb_{1.48}Te_3$ (II) SOLID SOLUTIONS PREPARED BY SUPERHIGH COOLING RATES

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86 (manuscript received 23 Apr 84) pp 36-40

[Article by V. M. Glazov and Yu. V. Yatmanov, Moscow Electronic Engineering Institute]

[Abstract] Since very rapid cooling of semiconductor melts has been shown to yield essentially chemically homogenous materials, similar attempts were conducted with a superhigh rate (ca. 10^8 K/sec) of cooling of I and II melts, with a subsequent analysis of these solid solutions in terms of the temperature dependence of their thermoelectric characteristics and an estimation of the thermoelectric factor of merit. Analysis of the electrical conductivity, heat conductivity, thermo-emf coefficient and the thermoelectric factor of merit over a temperature range of 250 to 550 K for I and II demonstrated significant differences between the solid solutions and their melts. In addition, differences in the electrical parameter ((thermo-emf coeff.)^2 x (electrical conduction)) for I and II and the higher values for the solid solutions than for the melts indicated that superhigh cooling rates induced different changes in the electronic subsystems of p- and n-type conductors. In the former case (I), a superhigh rate of cooling increases the concentration of free carriers, and in the latter case (II) decreases it. In both cases there is a gain in the thermoelectric factor of merit. References 6: all Russian.

12172/12955
CSO: 1842/164

UDC 564.86'24

MICRO X-RAY SPECTROSCOPY OF Sb_2Te_3 MONOCRYSTALS DOPED WITH Sn and Tl

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86 (manuscript received 14 May 84) pp 52-55

[Article by Sh. Mavlonov and P. N. Sherov, Physical Technical Institute imeni S. U. Umarov, Tadjik SSR Academy of Sciences]

[Abstract] In view of the unsuccessful attempts at changing p-type conductivity of Sb_3Te_3 crystals to n-type conductivity, micro x-ray spectroscopy and micrscopic analyses were performed to define changes induced in such crystals by doping with Sn and Tl. Introduction of Tl to a concentration of 0.01 wt% yields a preparation with homogenous distribution of the doping agent, whereas higher concentrations of Tl (0.1 or 0.3 wt%) leads to heterogeneity in the crystal. On doping with Sn uniformity was observed to a concentration of 1.0 wt%. References 11: 8 Russian, 3 Western (1 in Russian translation).

12172/12955
CSO: 1842/164

UDC 546.681.3'171.1

X-RAY PHASE ANALYSIS AND ELASTIC PROPERTIES OF GaN

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 27 Feb 84) pp 63-66

[Article by I. F. Chetverikova, M. V. Chukichev and L. N. Rastorguyev (deceased), Aviation Technological Institute imeni K. E. Tsiolkovskiy, Moscow]

[Abstract] X-ray phase analysis was conducted on thin films of GaN deposited on sapphire substrates with different orientations, in order to explain the differences in optical characteristics of GaN light emitting diodes based on such substrates. Thin films (<20 μm) of GaN possessed several orientations with trace presence of an amorphous phase. Thicker films (>20 μm) are largely in the (0001) orientation when deposited on (0001) α-Al_2O_3, and in the $(11\bar{2}0)$ orientation when on $(10\bar{1}2)$ α-Al_2O_3. In addition, tabulated data are also provided for the parameters of the elementary cell of GaN films on (0001) and $(10\bar{1}2)$ α-Al_2O_3, and the values of Young modulus and Poisson coefficients for various crystallographic alignments in GaN. References 10: 4 Russian, 6 Western.

12172/12955
CSO: 1842/164

UDC 539.21:669.018.45

DEFORMATION PACKING DEFECTS IN TITANIUM AND VANADIUM NITRIDES

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 28 Apr 84) pp 67-70

[Article by I. I. Timofeyeva, A. A. Rogozinskaya and V. S. Polishchuk, Institute of Materials Science Problems, Ukrainian SSR Academy of Sciences]

[Abstract] X-ray phase determinations were conducted on samples of titanium and vanadium nitride prepared by vibration milling, to assess packing defects that affect the structural characteristics of such materials. Microdistortions in the titanium and vanadium nitrides were a significant factor and indicated the occurrence of plastic deformations which were not compensated for by recrystallization. Calculation of the energy of the packing defects for titanium nitride yielded a value of 190 ergs/cm^2, and 130 ergs/cm^2 for vanadium nitride. The high energies for the formation of the packing defects were attributed to the characteristics of the chemical bonds. References 9: 4 Russian, 5 Western (2 in Russian translation).

12172/12955
CSO: 1842/164

UDC 542.973.2

HIGH TEMPERATURE MAGNESIUM AND SILICON OXIDE COMPOSITES

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 4 May 84) pp 84-87

[Article by A. S. Ivanova, V. A. Dzisko and E. M. Moroz, Catalysis Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] An analysis was conducted on the effects of the components, calcination temperature, and initial component ratio on the phase composition, structure and strength characteristics of composites prepared from $Mg_2(OH)_2CO_3$, $Mg(OH)_2$, MgO, Aerosil, and silica gel. Prepared at temperatures ranging from 970 to 1820 K, four series of composites were tested. The results are presented in tabular and graphic forms. The data demonstrated that in high-temperature composites, based on magnesium and silicon oxide, the degree of interaction of the initial reactants is favored by replacement of oxide forms by the hydroxide forms as the temperature of calcination is increased. The surface area of the various samples indicated and reflected phase transitions in the various systems, while mechanical stability (strength) diminished with an increase in the total pore volume, which was greater with the use of the hydroxide form of the initial reactants. References 4: all Russian.

12172/12955
CSO: 1842/164

NEW METALLIZED PLASTIC BUSHINGS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA In Russian 20 Feb 86 p 4

[Article "Instead of Bronze" under the rubric "Made in the USSR," with the tag line "Selected from material from the Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk, ul. Malysheva, 101 TsNTI"]

[Text] Replacing bronze bushings with plastic ones in one blooming mill pivot joint alone saves 15-30 tons of nonferrous metal. The metallized plastic structure ensures transfer of sufficiently high torque, and production and maintenance are twice as easy. The plastic inserts are replaced once every 3-5 months.

12809/12955
CSO: 1842/163

CREATION OF AN EMERALD

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 Mar 86 p 4

[Article by Yu. Svintitskiy, special correspondent, Novosibirsk: "Creation of an Emerald"]

[Text] One fine day, a tall, broad-shouldered young man with a determined expression on his face walked along Moscow's streets. At times he smiled to himself, imagining how surprised passers-by would be if they knew what was in his pocket -- a complete treasure. He was Gennadiy Vasilyevich Bukin, junior scientific associate at the USSR Academy of Sciences Siberian Branch's Institute of Geology and Geophysics, who had just arrived in the capital. His route took him directly to the USSR Ministry for Finances.

He was received by a department head and, without a word, put what was in his pocket on the man's desk.

"Is it really an emerald?" said the head in surprise.

"You can make certain of it yourself," Bukin answered.

Experts were immediately summoned and they confirmed that it was indeed an emerald. But they had problems determining what deposit it came from.

"Not from a deposit, from a laboratory," said Bukin, to the amazement of the rest. "We need to...we're still making..."

Several minutes later, they were both in the deputy minister's office. From there, they went to the minister. There was no need to be surprised at this turn of events -- on the international market, an emerald like this was worth hundreds of dollars per carat, one-fifth of a gram. And this wasn't a single crystal, but a whole concretion. The druse had at least a thousand carats.

USSR Gosplan learned of the sensational specimen. A special monocrystal design-technological bureau was quickly organized in Novosibirsk for further work on producing the miracle-crystals. Bukin heads it now.

It all began with the liberty junior scientific associate Gennadiy Bukin allowed himself in the laboratory headed by A. Godovikov (then on an extended business trip). Bukin decided to delve into the secret of emerald synthesis.

An emerald is so valuable that more or less large specimens, which rarely occur in nature, are more expensive than diamonds. Adventurers of every stripe have hunted for these stones, and expeditions set off for the scorching sands of Africa and the impenetrable jungles of South America. From the earliest times, the emerald was considered a powerful talisman, an aid to vision, an intidote for poisonous snake bites. According to ancient Russian superstitions, it gave its owner wisdom, composure, and hope.

In addition, many researchers dreamed of producing an emerald under laboratory conditions. But it never happened! They had already learned to grow rubies in the flame of a burner, and the invincible diamond had already been synthesized. But the emerald still had not yielded.

This is why the Institute, on Academician Sobolev's initiative, created a special laboratory to study and model the mineral-forming processes which occur in the earth's crust. A real "Hell's kitchen." Work on scapolite, a relative of the emerald, had already given Bukin some understanding of the processes. The chemical formula for beryl, of which emerald is a variety, was no secret. It was more complicated to define the role of the minute inclusions of chrome and vanadium which can also give the crystal its amazing, inimitable green color. It also helped that natural crystals contain inclusions sometimes microscopically small, which, as a criminologist would say, were evidence of formation conditions. Studied using special methods, these inclusions "betrayed" the emerald's entire pedigree and helped determine the temperature and pressure at which the mineral should gradually form.

When Godovikov returned from his trip, Bukin showed him the first crystals. He astounded his boss. This was the beginning of brilliant work by a group of scientists which included, besides Bukin, Godovikov himself and their colleagues, V. Klyakhin, A. Lebedev, V. Sobolev, and A. Tkachenko, who were able to take a laboratory success to industrial production.

"Now we can show you something interesting," said Gennadiy Vasilyevich Bukin when we met. "It's true that that 'historic' druse did not survive. Our country needed the carats. But you'll be surprised at our treasure."

Before me was a steel door. The right combination was selected, and the door swung to the side. So far, everything fit my concept of how one gained access to a treasury. But instead of the expected splendor there was a pile of chemicals and some kind of laboratory equipment. This is what a modern "Aladdin's cave" looked like. However, there was another, barely noticeable door in the room. It was opened with appropriate ritual, and in my hands there was the cherished green box, which, they told me, contained treasures. Trembling in spite of myself, I opened the lid...

...For a long time, ore experts and prospectors, who more than once brightened the world with their surprising finds, were unable to find a single emerald in Russia. Admittedly, even Pliny in the 1st century A.D. wrote about Scythian emeralds, supposedly found in the Urals. But this was considered to be the echo of a legend. Then suddenly, a sensation.

At the end of 1830, an obscure tar distiller named Kozhevnikov came to Yakov Kokovin, head of the Yekaterinburg Gem Factory and showed him what he considered "bad aquamarines" which he had found under an upturned stump. Kokovin was rightfully considered an expert in stones. A serf's son, who displayed unusual ability when it came to stone-cutting, he was freed and created several remarkable vases which are still preserved in the Hermitage. And in the "bad aquamarines" he recognized emeralds! Soon the whole world was talking about the discovery of a new, extremely rich deposit in the Urals.

The influential noble and collector L. Perovskiy accused this man, famous for his honesty and incorruptibility, of the theft of a unique stone "weighing a pound," about which he wrote, "Almost exceeding the value of the emerald in Julius Caesar's crown." Kokovin's career ended at this point, and he died in obscurity soon after. The lost emerald disappeared. Years later, Academician Ferman would tell how the unique Kokovin Emerald, the largest mined in our country, was found. It is now preserved in the USSR Academy of Sciences Mineralogical Museum. Only now has it been established that it was not the reason for Kokovin's prosecution and imprisonment.

Naturally, I didn't expect to see that stone in the box. But perhaps something similar? Especially since I had become familiar with the wonder created by human hands.

The box's lid was raised...And a splendid concretion of crystals was revealed -- a perfect druse, capable of adorning any treasure-house, filled with the unique green considered standard. This specimen could probably contend with the Kokovin. It is virtually impossible to distinguish these artificially grown stones from the natural. Only the most intricate modern diagnostic methods make it possible, and then with difficulty, only because they are more perfect than natural stones.

It is not only the emerald's beauty and rarity that have attracted those who so energetically impelled the Siberian scientists' development into existence. The jewelry industry needed such a remarkable gem. What's important is that another gripping fate awaited the bright green crystals -- one without detective-story twists. They turned out to be extremely critical in quantum electronics and nonlinear optics. Specialists believe that the emerald is an exceptionally promising material for UHF amplifiers, maser resonators operating in the 3-cm range, and also for traveling wave masers used in astronomical research.

"Yes," says Gennadiy Vasilyevich, "The emerald, although it became our first creation, was the starting point for work on new, truly miraculous crystals."

During the experiments on emeralds, Bukin and his colleagues noticed that, as it grew, some kind of "side" crystals appeared. When they studied these crystals, it turned out that they were the emerald's closest relative, chrysoberyl, and a variation of it also created by incredibly small inclusions, alexandrite.

In the room of the Special Design-Technological Bureau, they showed me a unit entirely consisting of monitoring and control equipment. At its center was an aperture in which a red-glowing icicle appeared. I was lucky enough to witness one of the wonders that had been grown. A mystery invisible to the eye took place -- from a molten charge, the body of a mineral even rarer in nature than an emerald was being built up. The celebrated alexandrite, about which they said in olden times, "In the morning it's green; in the evening, red," was growing. This saying points out its remarkable inherent optical effect: in sunlight, it is green; but in the evening, in artificial light, it glows with blood-red fire. For this reason, as well as because it it one of the hardest gems, experts and connoiseurs honor it.

Once again, it's not aesthetic merits that excite researchers. Chrysoberyl and alexandrite crystals are also extremely necessary in quantum electronics instrument building. While extremely small formations with different kinds of cloudiness and impurities occur in nature, the Siberian scientists' units grow blocks in sizes unheard of under natural conditions -- up to 120 millimeters -- with splendid optical characteristics.

The needs of the creators of newer and newer instruments, quantum electronics devices, superspectrographs, and communications equipment for nontraditional materials are constantly growing. For this reason, a genuine Cinderalla story is being written for many exotic and rare minerals. Some special references don't even mention one of them -- paratellurite. According to Bukin, it is found under natural conditions in only two deposits on the planet, and even then in barely identifiable granules. However, paratellurite has unique properties.

I was able to see crystals of this mineral, ideally transparent as pure water, as jewelers say, in the same green box next to the emerald. They were produced there at the Monocrystal Bureau. It turns out that these hand-made chunks of the substance can be used to exert exceptionally precise control over a beam of light in the most complicated instruments, information can be transmitted over them, and they are ideal for creating holographic memory systems. Light- and sound-guides made of paratellurite are used in manufacturing multi-channel modulators, deflectors, and radio frequency spectrum analyzers and for other purposes.

Creation of such crystals in laboratories, and then under industrial conditions is a remarkable victory of scientific and technological thought. But it still requires a jeweler's genuine craftsmanship, experience, and subtle intuition. Ideal purity in the laboratories is not so much an aesthetic requirement as a production necessity. In many cases, it's a question of incredibly minute inclusions, fractions of degrees of temperature, and the smallest pressure gradients.

"At first," says Bukin, "We were literally tormented by what we considered to be the whims of experts who had evaluated our emeralds. We'd present a sample. They'd say, "The color is too deep.' We'd make it lighter. 'No, a little deeper.' Then we understood that the human eye, even an expert's, cannot be trusted. So, for the first time in practice, we developed a color

evaluation technique. We photograph the absorption spectrum and obtain light characteristics in digital form. It turns out to be, an order of magnitude higher than what a human eye can do. Then there is no arguing."

The history of artificially grown precious crystals -- Siberian gems, as they are called -- has been built on a chain of remarkable events which have divined Nature's secrets. I was reminded of the old superstition that a gem gives people luck in battle. But it didn't work out that way with Kokovin. And what's noteworthy is that history turns out to be more just to the memory of the remarkable stone-cutter than to his contemporaries. It was recently established that he was deliberately slandered and sent to prison on the charges of the greedy noble Perovskiy, who apparently also appropriated the precious relic. Kokovin's name has been cleared.

Now the fate of precious gems is different. Created by the creative research and labor of scientists and industrial workers, they serve the people and science and make it possible to reveal new secrets of the world around us.

12809/12955
CSO: 1842/163

UDC 620.179.16

MINICOMPUTER-AIDED STUDY OF HIGH-TEMPERATURE CRYSTALLIZATION BY ACOUSTIC EMISSION METHOD

Sverdlovsk DEFEKTOSKOPIYA in Russian No 10, Oct 85 (manuscript received 29 Nov 83, in final version 15 Apr 85) pp 7-13

[Article by E. L. Lube and A. T. Zlatkin, Crystallography Institute, USSR Academy of Sciences]

[Abstract] An automatic system on a minicomputer base has been developed and constructed for study of high-temperature crystallization by the acoustic emission method. The system is designed to cope with the six major difficulties of flaw detection in crystals by this method. These difficulties are: long duration of the crystallization process, movement of the crystal during measurements, operation of piezoelectric transducers with preamplifiers throughout the process within the high-temperature zone in a strong alternating electro-magnetic field, presence of spurious sources of acoustic emission in the crucible and in the crystallizer, enlargement of emitting and sound conducting volume in the crystal during growth with attendant changes in the temperature distribution and a variety of structural and phase changes in the crystal resulting in acoustic emission. The system hardware consists of an M-6000 minicomputer with complete interface, input-output modules for discrete signals of various magnitude levels and analog-to-digital converters operating at various speeds, all designed so as not to require special coupling devices. In the absence of a priori information about the characteristics of acoustic emission, owing to the peculiarities of the crystallization process, the filter is set for a wide pass band of 60-1000 kHz and the amplitude discriminator is set for a range of threshold levels corresponding to 5-10 mV at the preamplifier input. Automatic analysis of acoustic emission data and subsequent identification of flaws are demonstrated on three typical examples of three respective classes of flaws and corresponding acoustic emission signals generated in crystals of refractory dielectrics: 1) formation of microcracks in the crystal seed, characterized by large-amplitude signals with high average mean pulse-packet frequency and narrow spread of mean pulse-packet frequency and including only a few signals at frequencies below 80 kHz; 2) precipitation of spurious phase in the crystal, characterized by a large total number of small-amplitude signals with 70% of them covering a wide frequency range and including many signals at frequencies below 80 kHz; 3) development of crack inside the crystal,

characterized by very large amplitudes and long durations of signals whose mean pulse-packet frequencies and their distribution need not be known for identification of flaws. Crystallization process parameters are also recorded, for processing by the computer and correlation with crystal characteristics. References 4: 1 Russian, 3 Western (1 in Russian translation).

2415/12955
CSO: 1842/104

UDC 621.315.592

TEMPERATURE DEPENDENCE OF THERMAL EMF IN DIAMOND CERAMICS OVER 300-900 K TEMPERATURE RANGE

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 85 (manuscript received 17 Jul 84) pp 11-13

[Article by A. V. Bogdanov, Kherson Industrial Institute, T. V. Bogdanova, Kherson Pedagogical Institute, A. S. Vishnevskiy, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev, and I. M. Vikulin, Odessa State University imeni I. I. Mechnikov]

[Abstract] The thermal emf in semiconductor ceramics containing synthetic AS20 diamond as well as AS2 diamond and black SiC in various ratios was measured over the 300-900 K temperature range. The grain size of all ingredients was within the 40-60 μm fraction and 10 wt.% borax was added as binder as well as for scouring the SiO_2 film of the SiC grains. Specimens for testing were formed into disks either 4 mm or 12 mm in diameter and 2-10 mm thick, with electrical aluminum contact tabs deposited on them by the Schoope metallization process. They were placed in holes made in a fireclay brick and so inserted at a certain speed into a 1000-1100 K hot furnace, with air or water cooling at the other end. The temperature of a specimen was defined as the arithmetic mean of the readings of two thermocouples at its ends and the thermal emf was measured with a V7-27A voltmeter. The results reveal that both AS20 diamond and SiC behave like p-type semiconductors at room temperature, the 90 wt.% AS20 + 10 wt.% SiC mixture having the largest Seebeck coefficient which slowly decreases to a minimum at 650 K and then increases fast as the temperature rises further, while AS2 + SiC mixtures change from p-type to n-type behavior as the temperature passes through the 700-800 K range. As the AS2 diamond content in these ceramics is decreased, this change from p-type to n-type behavior occurs at lower temperatures and is followed by a return to p-type behavior at higher temperatures. References 2: both Russian.

2415/12955
CSO: 1842/138

UDC 541.135.5

EFFECT OF ELECTROCHEMICAL TREATMENT ON PROPERTIES OF DIAMONDS

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 85 (manuscript received 12 Sep 84) pp 13-15

[Article by G. P. Bogatyreva, M. A. Marinich, G. A. Bazaliy and L. A. Sokhina, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] Electrochemical treatment of diamond powders was studied, a major problem with such a treatment being to facilitate passage of electric current. The process begins with separation of magnetic and nonmagnetic fractions. The nonmagnetic fraction is then split by flotation into foam and vault products. The foam product is further split into electrically conducting and nonconducting fractions. This treatment was applied to AS32 400/315 diamond powder, in a P-5848 potentiostat with a platinum mesh electrode as crucible and 1 n HCl solution as electrolyte. The magnetic fraction, the nonmagnetic vault product, and the nonmagnetic electrically conducting foam product were thus separated for measurement of their picnometric density (3.97, 3.64, 3.51 g/cm^3), full specific surface area (0.087, 0.116, 0.083 m^2/g), magnetic susceptibility (32.0, 3.4, $4.5 \times 10^8 kg/m^3$), and electrical resistivity (0.9, 1.5, 0.5×10^8 ohm m). The results indicate the feasibility of electrochemically producing diamond powder with a high electrical resistivity and the necessity of controlling its initial physico-chemical properties. References 7: all Russian.

2415/12955
CSO: 1842/138

UDC 621.793.16:621.921.34

PLASMOCHEMICAL METALLIZATION OF DIAMOND

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 85
(manuscript received 4 Sep 84) pp 28-29

[Article by V. N. Vasilyev, V. T. Vesna and V. P. Maslov, Kiev]

[Abstract] An experimental study of diamond metallization by the plasmochemical process was made, coatings of refractory metals being deposited from the gaseous phase of halides in a glow discharge. Halides of metals were vaporized under an initial vacuum, their pressure being determined on the basis of evaporation temperature readings. Glow discharge was produced by a 10 kV source delivering a direct current of 300 mA. With the diamond substrate at a fixed temperature, the temperature of coating deposition was regulated over the 600-900°C range by increasing the discharge power up to 20 W/cm^2 and correspondingly decreasing the power of the external heater. In this way Mo_2C, $(Mo,Ti)_2C$, $(Mo,W)_2C$, and (Mo_2C+ SiC) coatings were produced, the deposition process beginning at 600°C already. Thickness and phase composition of the coatings were monitored with a DRON-3.0 x-ray diffractometer. The mechanical strength of ARK4 200/160 diamond, with such coatings and also bare, was tested by rubbing 400±0.1 mg specimens for 60 s between two parallel cast-iron plates oscillating linearly in phase opposition with an amplitude of 100 mm at a frequency of 1 Hz. The results of this experiment reveal that the metallization activation energy is the same for deposition from the gaseous phase with or without superposition of an electric field. Use of plasma, however, yields coated diamonds with 20-60% higher mechanical strength in one fifth of the time (in 5 min) at much lower temperature (700-750°C). References 4: all Russian.

2415/12955
CSO: 1842/138

UDC 541.64:539.3

DISCRETE STRENGTH SPECTRUM OF POLYMER FIBERS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 3 Jul 84) pp 70-74

[Article by G. M. Bartenev, A. I. Koblyakov, A. G. Barteneva and A. Ye. Chalykh, Physical Chemistry Institute, USSR Academy of Sciences, Moscow; Moscow Textile Institute imeni A. N. Kosygin]

[Abstract] The strength spectrum of polymer fibers, specifically caprone fibers, is analyzed on the basis of experimental data and their evaluation in accordance with laws of fracture mechanics and polymer mechanics. The data reveal a discrete spectrum of crack lengths and thus a discrete distribution of breaking stresses. Three lots of 300 fibers 24.6 μm in diameter and 2.20 and 200 mm long respectively were tested in an Instron tensile testing machine at approximately the same strain rate of $4.15 \cdot 10^{-3}$ s^{-1} in each case. The evaluation of data took into consideration the specific molecular structure of caprone as well as the energy characteristics of its C-C and C-N bonds. The results of this evaluation, essentially confirmed by examination under an electron microscope, indicate that the minimum submicrocrack length l_0= 20 nm corresponds to the most likely microfibril width w= 23.5 nm and the upper strength limit of 1230 MPa, while the maximum macrocrack length l_0= 2800 nm corresponds to the lower strength limit of 146 MPa. The existence of a discrete strength spectrum and corresponding crack length distribution is attributable to longitudinal and transverse discreteness of a uniaxially oriented polymer material. References 20: 19 Russian, 1 Western.

2415/12955
CSO: 1842/141

UDC 620.193.6

RADIATION-INDUCED STRESS CHANGE IN POLYMERS UNDER ELECTRON BOMBARDMENT

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 21, No 6, Nov-Dec 85 (manuscript received 24 Jul 84) pp 74-78

[Article by Ye. A. Barbashev, V. A. Bogatov, V. N. Kozin and B. I. Panshin]

[Abstract] An experimental study was made for verification of a theoretical relation describing ratiation-induced stress change in polymers as an exponentially decreasing function of time. Specimens of 50 μm thick uniaxially oriented F-4 teflon film, s0 μm thick biaxially oriented polypropylene films with respectively 600% and 900% extrusion in both mutually perpendicular directions, and 20 μm thick nonoriented polyethylene terephthalate film were loaded in tension to a state of quasi-constant stress and strain. After an electron beam had been turned on, for bombardment of the films at a constant power for 20 min, stress-time curves were recorded during and beyond the bombardment period, with the specimens loaded in tension at a deformation rate of 15 mm/min to various strain levels and then held at these levels for 60-90 min so as to ensure stress relaxation but not more than 5% of the radiation-induced stress change. The tests were performed at a constant temperature of 295 K, with the maximum bombardment power limited by the requirement that both the radiative heating of specimens and the stress change caused by buildup of the bombardment dose remain negligible. Evaluation of the data, taking into consideration the molecular structure of those polymers and the energy characteristics of their C-C bonds, has yielded relations for the time constant of the radiation-induced stress change process with attendant breaking of the C-C bond which validate that proposed equation. References 9: 8 Russian, 1 Western (in Russian translation).

2415/12955
CSO: 1842/141

UDC 621.382.823.002

PHOTOLUMINESCENCE OF EPITAXIAL GaAs LAYERS SIMULTANEOUSLY DOPED WITH S AND Sn

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 7 May 84) pp 5-8

[Article by Ye. I. Oborina, V. G. Melev, L. P. Porokhovnichenko and P. Ye. Ramazanov]

[Abstract] A He-Ne Laser LG75-1 was employed for excitation in photoluminescence analysis of epitaxial GaAs layers doped with S and Sn to determine the effects of simultaneous doping on flaw behavior. The resultant tabulated and graphical data demonstrated that all samples had bands at 0.96, 1.02, 1.22, 1.3 and 1.35 eV, correlated with the respective vacancy-donor centers (V_{Ga}-V_{As}), (Cu_{Ga}-V_{As}), (V_{Ga}-S_{As}), ($S_{As}Cu_{Ga}V_{As}$) and ($V_{As}Cu_{Ga}V_{As}$). Quasichemical reactions were proposed to account for these defects, represented in the form of concentrations of the reactive components. References 12: 4 Russian, 8 Western.

12172/12955
CSO: 1842/164

UDC 621.315.592

HETEROGENOUS EQUILIBRIA IN QUASIBINARY Bi-GaAs SYSTEM

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 26 Apr 84) pp 9-12

[Article by R. Kh. Akchurin, Le Din Kao, D. N. Nishanov and V. I. Fistul, Moscow Fine Chemical Technology Institute imeni M. V. Lomonosov]

[Abstract] A study was conducted on heterogenous equilibria in quasibinary Bi-GaAs systems by the growth of epitaxial layers of GaAs from melts containing Bi as a solvent, thus assuring maximal Bi levels in the system. Heterogenous equilibria were assessed at the three-component (Ga-As-Bi) stage of the phase diagram, corresponding to a quasibinary Bi-GaAs system. The solubility of Bi in GaAs was directly proportional to the temperature in the 700-800°C range, and on the order of ca. (1-6) x 10^{18} at/cm^3. Within the same temperature constraints the partition coefficient for Bi ranged from ca. 3 x 10^{-5} at 700°C, to ca. 5 x 10^{-4} at 800°C. Using highly and quasiregular models for the liquid and solid phases indicated that the former provided a more accurate characterization of the heterogenous equilibria, yielding a solubility value for Bi in GaAs of ca. 6 x 10^{13} at/cm^3 at 400°C and ca. 6 x 10^{20} at/cm^3 at 1180°C. References 9: 7 Russian, 2 Western (1 in Russian translation).

12172/12955
CSO: 1842/164

UDC 546.57'24'23'22:537.32

THERMOELECTRIC CHARACTERISTICS OF Ag_2Te-Ag_4SSe ALLOYS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 13 Apr 84) pp 26-28

[Article by V. Vasilev, Z. Boncheva-Mladenova and P. P. Petrov, Advanced Institute of Chemical Technology, Sofia, Bulgaria; Lvov Polytechnical Institute imeni Lenin's Komsomol]

[Abstract] An analysis was conducted on the thermoelectric characteristics of various Ag_2Te-Ag_4SSe samples as a possible novel agent for the transformation of heat energy into electric energy. Graphical data are provided for temperature-related changes in thermal conductivity, electrical conductivity and the thermo-emf coefficient of the alloys over the temperature range of 80-400 K. Analysis of the data in terms of alloy composition indicated that a new phase is formed when the concentration of Ag SSe component is at 50-60 mol%. Additional calculations showed that the highest value for the thermoelectric coefficient was obtained at 300 K for Ag_2Te (10^{-3} K^{-1}), and for pure Ag_4SSe at room temperature (0.4×10^{-3} K^{-1}). References 2: 1 Bulgarian, 1 Western.

12172/12955
CSO: 1842/164

UDC 535.347

PHOTOCONDUCTIVITY OF SINGLE $Bi_{12}SiO_{20}$ CRYSTALS DOPED WITH Mn AND Cr

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 2 Aug 83) pp 103-106

[Article by M. V. Shilova, V. M. Orlova, Ye. I. Leonov, Ye. Ye. Kolosov and I. A. Karpovich, Gorky State University imeni N. I. Lobachevskiy; Gorky Research Physicotechnical Institute]

[Abstract] The effects of doping single crystals of $Bi_{12}SiO_{20}$ (BSO) with Mn and Cr on photoconductivity and impurity-induced photoconductivity were conducted on BSO containing 0.15 wt% Mn and 0.10 wt% Cr. Both pure and doped BSO showed an essentially equivalent dark current of ca. 10^{-13}A. An increase in photoconductivity was induced by illumination with unfocused light from a mercury lamp for 10 min, with subsequent quenching on illumination with a He-Ne laser (630 nm, 10 min). The quenching of induced photoconductivity by the red light in the Mn and Cr samples suggest a diminished lifetime of the charge carriers. In the case of Mn doping the red boundary which leads to induced photoconduction in the BSO crystals lies at 2.25 eV (550 nm), and in Cr doped BSO crystals at greater than 3.1 eV. References 7: 6 Russian, 1 Western.

12172/12955
CSO: 1842/164

UDC 548.0:535

EFFECTS OF RADIATION ON OPTICAL PROPERTIES OF SELECTED FERROELECTRICS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 10 Apr 84) pp 115-119

[Article by G. N. Pirogova, Yu. V. Voronin, V. Ye. Kritskaya, A. I. Ryabov and N. A. Malov, Physical Chemistry Institute, USSR Academy of Sciences]

[Abstract] Gamma- and electron irradiation were tested for their effects on a series of ferroelectrics (KH_2PO_4, CsH_2AsO_4, $KH_{2x}D_{2(1-x)}PO_4$, $CsH_{2x}D_{2(1-x)}AsO_4$, $LiIO_3$) to determine dose-OD relationships and changes in spectral properties. Both gamma-irradiation (^{60}Co, 0.06-6.3 Gy/sec, $10-10^7$ Gy dose) and electron irradiation from an U-12 linear accelerator (2.3×10^{-6} sec pulses, $\sim 8 \times 10^{-13}$J electron energy, 30 Gy dose) induced a dose-related increase in the OD interrupted by the appearance of absorption bands in the UV region. The appearance of the absorption bands in the single crystal samples were attributed to Al, Cu and Mg impurities, as well as to radiation-induced formation of anion radicals. The PO_4^{3-} group, for example, was shown to exhibit greater radiation stability than the AsO_4^{3-} group, which accounted for the differences in the behavior of KH_2PO_4 and CsH_2AsO_4 isomorphic crystals. Gamma irradiation of $LiIO_3$ led to the appearance of a new absorption band at 360 nm and altered the color of the crystal to yellowish-brown. Electron impulsation revealed absorption bands which were not apparent with gamma-irradiation because of the more intense increase in OD and a shift of absorption to a longer wavelength region in the latter case. References 16: 10 Russian, 6 Western.

12172/12955
CSO: 1842/164

UDC 537.226.33

SURFACE COMPOSITION AND STRUCTURE OF TRANSPARENT FERROELECTRIC ZTPL CERAMICS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 28 Apr 84) pp 135-138

[Article by V. I. Dimza, A. E. Krumin, Ye. N. Lubnin, Yu. Ya. Tomashpolskiy and and L. A. Shebanov, Latvian State University imeni P. Stuchka; Scientific Research Solid State Physics Institute; Scientific Research Physicochemical Institute imeni L. Ya. Karpov]

[Abstract] X-ray, Auger spectroscopy and photoelectric methods were employed in an analysis of the surface composition and structure of ferroelectric ZTPL (zirconium-titanium-lead-lanthanum) ceramics. The ZTPL specimens with 10 at% La were either cut and polished, annealed at 800°C in air for 5 h after polishing, or pickled in boiling H_3PO_4 for 5 min. Polished surfaces of ZTPL were observed to be complex in structure, with the exterior layer (ca. 0.1 μm thick) presenting an amorphous or highly disordered structure. The outer layer was, in addition, depleted in Ti and Zr, and was removed only by chemical pickling. Masurements of photoconductivity in the surface layer demonstrated that the internal defective layer exhibited enhanced recombination of charge carriers. References 9: 4 Russian, 5 Western (1 in Russian translation).

12172/12955
CSO: 1842/164

UDC 621.762

SOVIET POWDER METALLURGY PROGRESS REVIEWED

Moscow STAL in Russian No 12, Dec 85 pp 55-59

[Article by Candidate of Technical Sciences V. B. Akimenko of USSR Minchermet [Ministry of Ferrous Metallurgy]: "Powder Metallurgy - Results and Problems" under the rubric: "Powder Metallurgy"]

In ferrous metallurgy the progressive technology of powder metallurgy is enveloping practically all specializations from the production of powders for different purposes to finished articles of complex shape used in making up the subassemblies and mechanisms of machines.

The principal problem for powder metallurgy is fully satisfying the steadily growing demand of the national economy for iron and alloyed powders. The most high-volume product of powder metallurgy is iron powder.

The development of the production of iron powders in the USSR has gone through three stages (Ref.1). From 1935 to 1951 laboratory and experimental industrial testing was done on a number of methods of obtaining iron powders which subsequently were used in the organization of industrial production. In the years 1952 to 1962, industrial production of small capacity was organized at the Sulinskiy and Novo-Tulskiy metallurgical plants. Since 1983, the production of iron powders has been substantially increased as the result of placing three new shops into operation at the Dneprovskiy aluminum plant, the Brovary powder metallurgy plant, and the Sulinskiy metallurgical plant.

Analysis of the trends in the development of powder metallurgy showed that the technology of atomizing liquid metal most completely solved the problem of the mass production of high-quality powders (Ref. 2-5).

In the production of iron powders, the principal advantages of the technology of atomizing liquid metal with water at high pressure are:

- the possibility of obtaining, along with iron powders, alloyed powders,
- the high quality of the product and the possibility of regulating the quality of powders in accordance with the demands of different consumers by changing the principal parameters of the technology in the course of the production process;

- high yield of suitable product (within the limits of 85-95 percent of the weight of the liquid metal, depending on the type of powder) with a high degree of wasteless production because of putting the secondary products back into the process (the coarse fraction of the powders) and control of wastes; and

- the use of progressive production, production transport, and suction equipment.

In the 11th Five-Year Plan substantial investments were made in developing new capacities for producing iron and alloyed powders. In this, fundamental changes took place in the technology. In the beginning of the 11th Five-Year Plan, only the methods of the reduction of oxides of metals with different solid or combined reducing agents, were used in producing powders. On the initiative of the management of the Brovary powder metallurgy plant, supported by the VPO [All-Union Production Association] Soyuzspetsstal and USSR Minchermet, a decision was adopted for reconstructing the iron powder shop.

According to the design of Ukrgipromez [Ukrainian State Institute for the Design of Metallurgical Plants] with the active participation of associates of the Brovary powder metallurgy plant, the Institute of Powder Metallurgy of the TsNIIchermet [Central Scientific Research Institute of Ferrous Metallurgy] and the Institute of the Problems of Materials Sciences of the UkSSR Academy of Sciences, a conversion of the shop was carried out (without its stopping) to the technology of the atomization of liquid metal air, and then by water at high pressure. The reconstruction permitted doubling the capacity of the shop with insignificant unit capital investments.

At the Sulinskiy metallurgical plant, the first stage of the largest shop complex in Europe for the production of iron and alloyed powders by the atomization of liquid metal by water at high pressure was put into operation (Ref. 6). The design of the shop complex was made by the institutes of Gipromez [State Union Institute for the Design of Metallurgical Plants] and Giprostal [State Institute for the Design of Steel Plants]. The production of low-alloy powders of the Ultrapak type by the method of the diffusion saturation of iron powders also will be organized in the shop.

The technology of the production of atomized powders consists of the following basic operations: the smelting of metal of the desired composition in two electric arc steel-melting furnaces and the atomization, with water at a pressure of 10-12 MPa, of the metal streaming from a ladle through two stopper devices. To reduce the oxidation of the metal during atomization, the process is carried out in a protective atmosphere. The stream of metal is dispersed by the high-pressure water and the resulting liquid particles are crystallized. Changing the specific consumption and pressure of the water and the angle of encounter of metal and water can regulate the granulometric composition and oxygen content in the raw powder. After dehydration and drying the raw powder is sifted, as a result of which the coarse fraction is separated from the basic mass and returned for remelting. After sifting, the raw powder is given a reducing annealing. For the annealing, six furnaces were installed in the

shop having walking beams and heating by means of radiant pipes, and a productivity of 2 tons per hour each. The annealing is done in an atmosphere of dissociated ammonia. The cake formed in the annealing process is subjected to a two-stage crushing, grinding, and classification. A requisite fraction of the powder is drawn for grading which assures uniformity of the given characteristics of the powder for the whole volume of each 10 ton batch. the graded batch of powder goes into an automatic installation for vacuum packaging in polyethylene bags.

The production of iron powder at the Sulinskiy metallurgical plant conforms to all modern demands for protecting the environment. It has a suction system assuring complete recovery of metal particles from the production equipment and a closed recirculating system for process water which prevents pollution of water reservoirs. The shop complex in the Sulinskiy metallurgical plant will permit satisfying the demands of consumers in all branches of industry and opens up vast prospects for the manufacture of articles of complex shape for construction purposes.

Iron powders are used primarily in the production of articles made from them, and welding electrodes. They also are used for oxygen-flux cutting, magnetic defectoscopy, and in the production of battery plates and other things.

While in 1974, 48 percent of the total amount of iron powder produced in our country was used for making articles made of iron powder and 40 percent in the production of welding electrodes and flux-cored wire, in 1984, 77.4 percent was used for producing articles made from iron powder and 15.9 percent was used for welding electrodes and flux-cored wire. This trend will be preserved in subsequent years.

In the USSR and abroad along with the known methods of improving the structure and properties of tool steels, a fundamentally new industrial technology has been developed for obtaining these steels by the method of powder metallurgy (Ref. 7-9). This technology has a number of advantages over the traditional ones such as:

- the possibility of manufacturing blanks, forgings, bars, and special shapes of relatively large dimensions free of segregation and having an outstanding fine-grain structure of the matrix with an even distribution of carbide inclusions, and with dimensions down to 2 micrometers;

- an increase in the output of suitable product in the processing of sintered blanks (deformation and heat treatment),

- the possibility of developing new high-speed steels and other hard to deform high-alloy steels and alloys having an elevated content at the carbide phase.

Industrial production of high-speed steel by the powder metallurgy method has been organized at the Dneprospetsstal plant (Ref. 10). The technology for smelting high-speed steel for atomization is practically the same as that used in the production of ordinary poured steel. Steel is melted in an open, 4 ton capacity induction furnace. Liquid steel from the furnace is poured into a well receiver from which, through a sleeve with a calibrated opening, the metal flows at a specific speed into the column for atomization where there are gas nozzles through which the nitrogen used to disperse the stream of metal is fed into the column.

The production of metal without the carbide heterogeneity typical for cast high-speed steel is achieved by the dispersion of a stream of metal into individual particles which cool with a speed on the order of 10,000 degrees per second and turn into microscopically uniform particles of powder.

Further process operations are directed toward producing compact blanks from powder which are suitable for pressure shaping and the production of the finished articles of the metallurgical conversion.

According to the calculations of Gipromez and Ukrgipromez, the installation in the shop of an additional gasostat for compacting will permit increasing the capacity of the shop without substantial construction and installation work.

In the TsNIIchermet a method and an industrial process have been developed for making powders of titanium and chromium and their alloys and also powders of high-alloy steels and alloys by the reduction of oxides (and powders of metals and nonmetals) with calcium hydride (Ref. 11-12). This method provides powders of nonspherical particle shape and a spongy structure which gives good mouldability both in pressing and in the direct rolling of powder into plates and strips. In the first years of operation under industrial conditions, three sorts of powders of steels and alloys were produced and now more than 30 types of high-alloy powders are being produced (Ref. 3).

According to a Gipromez design, a unique complex, of which there is no analog in Europe, has been built at the NPO [Scientific Production Association] Tulachermet for the production of high-alloy powders. The high-alloy powders are made by the atomization of liquid metal with nitrogen. Typical for this method is a spherical shape of the powder particles (Ref.5). The capacity developed assures rapid development of the progressive technology of spray-deposition and surfacing Spray-deposition and surfacing high-alloy powders by various methods provides for restoring worn parts, for making parts having high-quality working surfaces from ordinary steels, and also for making unique articles having new technical capabilities.

The NPO Tulachermet is producing, for spray-deposition and surfacing, metal powders of three groups of alloys; namely, metallides, self-fluxing alloys, and high-alloy steels and cast iron (Ref. 14). The chemical compositions of the metallide powders supplied in accordance with TU [Technical Specification] 14-1-3282-81 are given in Table 1.

Table 1. The chemical composition (mass fraction, percent) of metallide powders

Type	Ni	Ti	Al	Fe	C	N
		Reduced powders				
PN70Yu30	Base	-	28-33	0.2	0.07	0.08
PN85Yu15	"	-	12-15	0.2	0.07	0.08
PN55T45	"	43-47	-	0.2	0.07	0.10
PT88N12	10-12.5	Base	-	0.2	0.07	0.10
PT65Yu35	-	"	35.5-40	0.2	0.07	0.08
		Atomized powders				
PR-N70Yu30	Base	-	28-33	2.0	0.07	0.08
PR-N85Yu15	"	-	12-15	1.0	0.07	0.08

The powders are divided into three classes according to grain size. Class OM contains 10-45 micrometer particles, class M contains 20-63 or 40-100 micrometer particles, and class S contains particles not less than 160 micrometers.

Each powder particle is a compound of a metal with a metal. For instance, PN70Yu30 corresponds to the compound NiAl, and PN85Yu15 to Ni_3Al.

The industrial use of plasma coatings based on metallides can be illustrated by the following examples. The cylinder liners of large diesels installed on diesel locomotives and river and seagoing ships, after wear of the working surface, are not restored. Work done jointly by the Uzlovaya locomotive depot of the Moscow railroad and NPO Tulachermet showed that 2D100 locomotive diesel cylinder liners, restored by the method of the plasma application of coatings based on PN85Yu15 are not only efficient, but after operational tests (190,000 kilometers of running) are worn one third as much as the manufacturer's liners installed in the same block. In this, after 140,000 kilometers of running, a 16 ton fuel saving was recorded.

Coatings based on PN70Yu30 and PN55T45 applied by argon and ammonia plasma were intended for the protection of water walls and other boiler units of great power. They increased the service life of the tubes by a factor of not less than three as a consequence of which substantial savings of metal and electrical energy are being achieved.

The chemical compositions of the powders of self-fluxing alloys produced according to TU 14-1-3785-84 are given in Table 2.

According to granulometric composition, the powders are divided into five [sic] classes; namely, 20-63 micrometers, under 40-100 micrometers, 80-160 micrometers, and 100-280 micrometers.

Table 2. Chemical composition (mass fraction, percent) of self-fluxing alloy powders

Type	Ni	C	Cr	Si	B	Fe	Mn	Hardness No HRC
PR-N80Kh13C2R	Base	0.2-0.4	12-14	2-2.8	1.2-1.8	to 5	-	25-35
PR-N77Kh15C3R2	"	0.35-0.6	14-16	2.8-3.5	1.8-2.3	to 5	-	35-45
PR-N73Kh16C3R3	"	0.6-0.9	15-17	2.7-3.7	2.3-3.0	to 5	-	45-55
PR-N70Kh17C4R4	"	0.8-1.2	16-18	2.8-4.5	3.1-4.0	to 5	-	55
PR-N67Kh18C5R5	"	0.9-1.5	16-19	4-5	4-4.7	to 5	to 1	60
PR-N65Kh25C3R3	"	0.9-1.5	23.5-26.5	2.1-2.3	2-3	to 5	0.05-0.35	45
PN68Kh21C5R	"	0.35-0.5	20-22	4-5	1.0-1.3	4-7	-	40

The hardness of a deposited layer depends on the type of powder as also indicated in Table 2. By chemical composition, the enumerated alloys are, basically, similar to the well known types PG-SR and SNGN; however, they differ in a reduced content of oxygen and other admixtures and also in different class division by granulometric composition which provides for their use not only for surfacing but also for spray-deposition. They make solid layers which are without pores which is especially important in developing the impermeable surfaces of fittings for high-pressure power plants. Powders of chrome-nickle alloys can be applied to assemblies and parts of machines by all known means of surfacing and spray-deposition. The coatings combine high wear resistance with corrosion resistance permitting the use of parts in conditions of impact loading and in aggressive media with abrasive wear at temperatures up to 600 °C. These powders are used for restoring and strengthening the valves and cam shafts of internal combustion engines, blades, rotors, fans, shafts and bushings of hydraulic pumps, parts of agricultural machines, and so on. For increasing the wear resistance of coatings, compositions based on self-fluxing materials are used having high-hardness fillers such as carbides, borides, and oxides.

The powders PR-15Kh12F6D and PR-29Kh14F12D are type Kh17 and Kh13 steels reinforced by the introduction into the matrix of borides and carbides of chromium and vanadium. They are used for the spray-deposition and surfacing of wear- and corrosion-resistant coatings. They provide coatings with a hardness number up to 55 HRC. Powders of the alloys PR-Kh18N and PR-Kh23N28M3D3T are used for the manufacture of porous articles for filtering aggressive liquids and gases and also for applying corrosion resistant coatings. Powders of alloys PR-10R6M5, PR-M6F3, and PR-Kh18FNM are for applying coatings by the method of plasma-jet hard-facing in strengthening stamping tools working under conditions of intense wear with impact loadings and also for making the working surfaces of cutting tools.

Powders PG-S27, PG-S1, PG-FBKh6-2, and PG-US25 are used for surfacing parts of metallurgical, agricultural, power engineering, mining, and other equipment working under conditions of abrasive wear in normal and elevated temperatures (up to 500 °C). They provide a hardness of the surfaced layer of above 50 HRC.

In the surfacing and spray deposition of the powder PRChN15D7, layers are obtained which are distinguished by corrosion resistance combined with wear resistance, heat resistance and high-temperature strength. The powder PR-ChYu22SG is used for the protection of parts working at high temperatures under conditions of gas corrosion and abrasive wear.

Powders of high-alloy steels and cast iron are produced with particle dimensions no greater than 630 micrometers, and by agreement with the client can be separated by class: OM (40-100 micrometers), M (100-200 micrometers) and S (280-630 micrometers).

Ferrous metallurgy is the largest supplier of articles based on iron powder. The production of such articles was begun at the Brovary powder metallurgy plant in 1964. Now this plant is the largest specialized enterprise in Europe with a complete production cycle from powders to articles for various purposes.

Compared with the ordinary methods of manufacture (casting, stamping, rolling) the method of powder metallurgy permits the manufacture of parts with special properties (porosity, antifriction properties, wear resistance and so on). In a number of cases it permits replacing nonferrous metals with less scarce materials (for instance, copper-iron with copper and ferrobrasses, and bronze with ferrographites). It also permits saving metal (the loss of metal including machining does not exceed 5-10 percent).

At the present time, the Brovary powder metallurgy plant has mastered the production of 250 designated articles of three basic groups according to purpose; namely, antifriction, construction and frictional articles. Of the total output of articles based on iron powder, the largest part is composed of articles for construction. The introduction of one part, the Kolpak hydraulic cylinder, at the Taganrog combine plant in the amount of 1 million units yielded an economic gain of 460,000 rubles as a result of freeing 32 units of metal cutting equipment and a reduction of the metal content of the part.

In mastering the production of frictional materials, for the first time in the world practice of producing friction disks specialists of the Brovary powder metallurgy plant developed a process for the continuous sintering of friction disks and two-sided simultaneous pressing of the friction layer.

The classical antifriction materials are alloys of various kinds of bronzes based on tin and lead. By powder metallurgy methods it is possible to make antifrictional materials having a complex of needed properties which replace many parts made of expensive nonferrous metals. Powder anitfrictional materials maintain the necessary combination of hard and soft structural components. The pores of antifriction powder materials are filled with oil, graphite, and sulphides of metals that increase antifrictional properties to a significant degree. Porous bearings run in better and have a lower coefficient of friction, and the greater wear resistance. Such bearings, as a rule, are self-lubricating and have the capability of regulating the

delivery of lubrication to the contact surfaces of rubbing pairs. The Brovary powder metallurgy plant produces more than 80 sizes of bearings having outer diameters of 4-150 mm and heights of 5-100 mm which are used in very different branches of machine building.

Construction articles made of powdered materials can replace a large part of the general purpose articles made of carbon and alloy steels, cast iron, and nonferrous metals. High-density of parts is achieved by two-stage pressing or the use of highly compactable iron powder having an additive of alloying elements enabling increased density in sintering. For increasing strength, wear resistance and corrosion resistance, construction parts undergo additional forms of treatment - hardening, thermal steam oxidation, and so on.

In the 12th Five-Year plan at the Brovary powder metallurgy plant the principal thrust will be to make a substantial expansion of articles of complex shape and increased precision for which a modern tool base is being developed and a substantial renewal of the stock of presses is taking place.

At the Sulinskiy metallurgical plant the construction of the shop complex will be continued and the volume of production of articles will be increased with an expansion of the assortment of them.

At the Vyksa metallurgical plant, with the active participation of the Gorkiy Polytechnical Institute, TsNIIchermet, the Institute of the Problems of Material Sciences of the UkSSR Academy of Sciences, and the Institute of Electric Welding imeni Ye. O. Paton, the technology for the manufacture of porous rolled stock has been mastered (Ref. 17-19).

For the production of porous steel plate, the powder of corrosion resistant steel PKh18N15 is used. Porous strip providing for a fineness of filtration of from 2 to 15 micrometers is being produced by the Vyksa metallurgical plant. The technical characteristics and basic purpose of the filters is given in Table 3.

At the Brovary powder metallurgy plant and the Vyksa metallurgical plant the production of strip by the method of rolling powders for wear-resistant and anticorrosion surfacing has been mastered.

The use of powder strips for surfacing yields a substantial economic gain in metallurgy and various fields of machine building and will be substantially expanded in the 12th Five-Year Plan.

The development and introduction of fundamentally new equipment and technology is becoming one of the decisive factors of the modern intensified development of the economy. Widespread use of the methods and materials of powder metallurgy is one of the ways of solving this problem in which a substantial contribution is borne by ferrous metallurgy.

Table 3. Characteristics and principal purpose of filters

Type	Thickness mm	Width mm	Length mm	Porosity %	Principal Purpose
Kh18N15-PM (FNS-2-3)	0.1-0.14	105	900	25-38	For the fine filtration of mechanical impurities from certain liquid and gaseous substances in the temperature range from -60 to +250°C.
Kh18N15-PM (FNS-5)	0.14-0.2	105	900	32-37	
Kh18N15-PM (FNS-10)	0.18-0.25	200-600	900	31-42	
Kh18N15-PM-5(NPS-5)	0.5-1 / 2.0-3.0	220-380 / 380-350	900	30-50	For the fine filtration of mechanical impurities from liquid and gaseous substances, and as a capillarly active material for the even distribution of a filtered substance. (TU-14-1-2173-77)
Kh18N15-PM-6(PNS-6)	0.5-1 / 2-3	220-380 / 380-550	800-1000	30-50	
Kh18N15-PM-8	0.5-1 / 2,3,5	220-380 / 380-550	800-1000	30-50	For condensing moisture from a steam line mixture at temperatures of 50-90°C.
Kh18N15-PM-10	0.5-1 / 2,3,5	220-380 / 380-550	800-1000	30-50	
Kh18N15-PM (NPL)	0.4-0.8	220-10	800 ±5	20-30	(VTU 201-70)[Departmental specification]
Kh23N28M3D3T(EI943)	1.1-1.2	500-600	320-1230	37.6-38	For the filtration of phosphoric acid.

REFERENCES

1. Akimenko V. B., Knyazev V. F., Gimelfarb A. I., et al, In the book: "Tematichesky otraslevoy sbornik" [Topical Industrial Sector Collection] Moscow, Metallurgiya , 1974, No. 1 pp 114-117.

2. Roll K., In the book: "Poroshkovaya metallurgiya" [Powder Metallurgy] Kiev, Naukova dumka , 1977, pp 53-60.

3. "Proshloye, nastoyashcheye i budushcheye poroshkovoy metallurgiya" [The Past, Present and Future of Powder Metallurgy] Document from the firm Khoganes, Sweden, Moscow, CHERMETINFORMATSIYA, 1978, No. 10541.

4. Akimenko V. B., Krasheninikov Ye. A., Rukin V. V., et al, POROSHKOVAYA METALLURGIYA, 1979, No. 9 pp 45-55.

5. Akimenko V. B., Bulanov V. Ya., Rukin V. V., et al, "Zheleznyye poroshki" [Iron Powders] Moscow, Nauka , 1982, 264 pages.

6. Akimenko V. B., Gimmelfarb A. I., Gipsh Ya. L., et al, STAL,1984, No.10 pp 76-78

7. Millins P. IRON AGE, 1973, vol. 13, No. 2, p 45.

8. Iron Age Metalworks Int. 1974, 13, No. 2, pp 37-38

9. Petrov A. K., Tsipunov A. G., Akimenko V. B., et al, "Raspylennyye poroshki bystrorezhushchikh staley" [Spray-deposited Powders of High-speed Steels] Poroshkovaya Metallurgiya [Powder Metallurgy] LatINTI [Latvian Institute of Scientific and Technical Information], Riga, 1975, pp 35-40.

10. Gimelfarb A. I., Akimenko V. B., Gipsh Ya. L., et al, STAL, 1981, No. 1, pp 79-84.

11. A.s. 127029 (USSR)/Petunina Ye. V., Lvovskaya V. P., Borok B. A., et al, Published in B. I., 1960, No.6, p 44.

12. Timoshenko N. N., Borok B. A., Petunina Ye. V., et al, TSVETNYYE METALLY, 1960, No. 3, pp 68-74.

13. Dzneladze Zh. I., Shchegoleva R. P., Golubeva L. S., et al, "Poroshkovaya metallurgiya staley i splavov" [Powder Metallurgy of Steels and Alloys] Moscow, Metallurgiya , 1978, 264 pages.

14. Geltman I. S., Rabinovich Ye. M., STAL, 1985, No. 4, pp 78-81.

15. Bolshechenko A. G., Gayduchenko A. K., "Sostoyaniye proizvodstva i perspectivy razvitiya Brovarskogo zavod poroshkovoy metallurgiya" [The Status of Production and Prospects for the Development of the Brovary Powder Metallurgy Plant] Poroshkovaya metallurgiya, LatINTI, Riga, 1975, pp 292-295.

16. Akimenko V. B., Bolshechenko A. G., Gayduchenko A. K., STAL, 1979, No. 3, pp 165-167.

17. Benko V. M., Vavilin A. S., Shmelev L. S., STAL 1982 No. 11, p 65.

18. Dzneladze Zh. I., Shchegoleva R. P., Lykova V. F., et al, STAL, 1982, No. 3, pp 80-85.

19. Shmelev L. S., Sorokin V. K., Gureyev N. V., STAL, 1983, No. 5, pp 82-83.

COPYRIGHT:Izdatelstvo "Metallurg", "Stal", 1985

9136
CSO:1842/123

ECONOMIZING AND IMPROVING QUALITY OF CASTING URGED

Moscow ZNANIYE-SILA in Russian No 12, Dec 85 pp 2-3

[Article by L. Rodzinskiy: "Casting. Economizing and Quality"]

[Text] The Smolnyy Institute building in Leningrad was constructed in the early 19th century. Its roof, laid with sheets of rolled iron, did not require painting or repair until it was pierced by shell fragments and bombs during the Great Patriotic War. The secret of the corrosion resistance and durability of the metal is not in alloying additions, but in iron of high purity, smelted by skilled workmen from the Kirs Metallurgy Factory in the city of Kirs, Kirov Oblast. In the furnaces of this patriarch of Russian metallurgical factories iron ore was smelted in charcoal and iron of rare purity, exceptional durability and corrosion resistance was obtained.

There is not enough charcoal in our day for mass production of high quality metal. And the remaining traditional casting equipment cannot solve the important task set at the April 1985 plenum: to achieve a 1.5-2 fold increase in the rate of machine building and a mandatory reduction in material intensiveness of new generation machines and equipment during the 12th Five-Year Plan. In other words, yesterday's equipment must "lose weight," without giving up a single technical specification.

Research conducted by scientists from the Kiev Casting Problems Institute, UkSSSR Academy of Sciences and the Metallurgy Institute, Ural Scientific Center, USSR Academy of Sciences, which has already received recognition in industry, will help to save millions of tons of steel, cast iron and non-ferrous metals, which are now dead weight in metallurgical casting, and at the same time improve the working conditions of the metallurgists.

A "Blanket" For Making Castings

A technical encyclopedia published more than a half century ago already depicted with sufficient detail how to obtain castings in a rapidly rotating metal mold out of steel, cast iron and various non-ferrous metal alloys. Under the influence of centrifugal force the melt seemingly adheres to the walls of the mold, obediently copying its profile. And to this day an extensive family of bodies of revolution -- bushings, axles, cylinders, pistons -- are manufactured in precisely the same way.

They are required most of all by machine builders, especially those who specialize in the production of various types of transport equipment. But there are also frequent exceptions. Imagine a thick-walled metal cylinder the length of a trolley bus, inside of which a grown man can walk freely. This cumbersome item is called a "paper making machine drying cylinder housing." Paper production is impossible without such cylinders. But for a long time it was not possible to manufacture this housing quickly and cheaply enough and at a high quality. Centrifugal casting specialists also stumbled on this problem. The castings, even when the requirements of the technology were most strictly observed, most often were defective. The mass of these housings is measured in tons.

Unavoidable oxidation of the melt occurs already in the pouring spout enroute to the mold. The oxide films are impossible to get rid of; they penetrate through the thickness of the product, reducing its load impedance in future service. In turn, concealed defects give access to gases and fluids, which is also impermissible in drying drums. Unavoidable slag inclusions, which cannot be completely removed from the melt, are no less fatal. Especially harmful is sulfur, the irreconcilable enemy of metallurgists. Due to it the casting became brittle and fragile, like glass, unable to withstand blows and jarring.

Finally, the larger and more massive the casting the more time is spent on the casting process. Streams of molten metal are still continuing to come out of the furnace, while the first portions, which "adhered" to the walls of the mold have already cooled. A so-called dendrite structure formed, recalling in its appearance frost designs on glass. Dendrites thirstily absorb metal, leaving numerous small holes in the gaps. The surface of such a premature casting became porous and pliable under pressures, like a snowdrift under a ski. Metal permeated by pores is removed by turning. But frequently microfissures penetrate too deeply, forcing the whole casting to be discarded.

What did the Kievans working in the Centrifugal Casting Laboratory headed by candidate of engineering A. I. Shevchenko undertake?

They invented and then put into practical use a specific means of protection against all of the above enumerated difficulties. Moreover, they learned to obtain multi-layer billets which possess fundamentally new physicomechanical characteristics.

Now there are two streams in the pouring spout of a centrifugal machine, a stream of white-hot metal and a synthetic multicomponent fusing agent flowing constantly from the collecting bin. It begins to accomplish its purpose as soon as it meets the white-hot melt. The fusing agent melts and reliably protects the metal from oxidation. And when it reaches the mold it is forced back to the periphery under the influence of centrifugal force. The molten fusing agent wraps up the future casting like a blanket, preventing intensive heat losses through the boundary wall and at the same time preventing the formation of the undesirable dendrite structure. Moreover, as a result of heat exchange with the molten metal, as well as contact with the air, certain chemical components of the fusing agent come into play. They begin to give off concealed exothermic warmth. In this way the undesired

cooling of the surface layers of the castings is completely eliminated. The faultless homogeneity of the macrostructure is guaranteed with a high degree of reliability. At the same time another group of components of the fusing agent operate actively in the still liquid casting. It has the narrowly defined purpose of carefully "combing" the melt and combining sulfur into compounds which are harmless to the future product.

Finally, there is one more beneficial role played by alloying additions. They enrich the characteristics of the future castings in a given direction. If required, they raise its thermal stability, plasticity, etc.

Having done its good deed, the "blanket" is easily removed from the cooled billet. Subsequent turning will remove only a very thin surface layer. And it is the powerful trunk of what is, from the point of view of state standards, an irreproachable "shirt," so necessary to the paper making industry. The only thing left to add is that, due to the stubborn striving of the Kiev researchers, the pioneer technology for manufacturing large caliber castings has been placed in series production at the Izhtyazhbummash factory in the city of Ustinov.

Now let me say a few words about the multilayer parts and assemblies of machines. Modern equipment has an ever increasing need for them. Take, for example, rolling mill rollers or cylinder rollers for processing of clay raw materials in brick factories, or back up rollers of conveyor systems. What do they have in common? They have actively abrading surfaces which require the use of abrasion resistant material. Although very insignificant in thickness, they are extremely necessary just the same. The remaining mass of the rollers or cylinders can be manufactured out of ordinary, run of the mill steel.

Other more complex examples could also be given. Let us say bushings on large capacity fleet diesels installed on merchant and factory ships. Until very recently they were manufactured in single layers made from cast iron, which withstood very well the friction created by constantly moving pistons. Only the difficulty is that these same bushings, which require constant cooling by flowing water, are quickly destroyed from the effect of cavitation -- microexplosions of extremely tiny water bubbles. As a result the service life of the parts is reduced more than three fold. And the unpleasantness which an emergency stop on the open sea entails goes without saying.

In short, it was necessary to develop the production of bimetallic bodies of revolution, each layer of which would possess clearly expressed individual characteristics. The same blanket of synthetic fusing agent solves all these problems. Now it has safeguarded and treated complex two-layer castings.

It is now no longer necessary to put costly and unreliable bands made of abrasion resistant materials on the rollers and to subject the rollers to costly and ineffective case hardening. The bimetallic bushings obtained by the new technology have sharply increased resistance to destructive cavitation and have already saved millions of rubles. The technology for manufacture of bimetallic bushings for drilling rigs, which has been transferred for industrial assimilation to the Krasnyy Molot factory in Groznyy, is no less effective.

If tomorrow Soviet technology requires goods which are still more difficult to manufacture, one need have no doubt that new methods of casting will also be suitable for the new machine building tasks.

Metallurgy -- Vacuum Tubes

How can impurities and occluded gas be quickly and completely cleaned out of smelted metal? One method we already know. Original research is being carried out in the physical chemistry of metallurgical melts laboratory of the Ural Scientific Center Institute of Metallurgy, USSR Academy of Sciences, headed by doctor of engineering B. M. Lepinskiy.

The theoretical premise of the Ural scientists was very unusual. They believed that between the melt of liquid metal and the gaseous environment there exists an autoelectronic emission. This is what the emission of electrons by the surface of the metal as a result of the influence of the external electrical field is called. The British physicist (Grove) back during the mid-19th century was first confronted with autoelectronic emissions. In his experiments metal was transferred with a gaseous discharge from the surface of a cathode to the walls of a tube. In this process the cathode "became thin," and the walls of the tube were covered with a metallic deposit.

The evolution of the technology placed the discovery at the service of radio engineering and electronics, and made mankind happy with radios, televisions and other electronic equipment. Now metallurgists are taking up autoelectronic emissions. Using the direction of movements of ions and electrons of metal and impurities they succeeded in displacing precisely those substances which it was necessary to get rid of, or on the other hand, with which it was necessary to saturate the melts. For this purpose, Sverdlovsk scientists sharply increased the difference of electrical potentials between the molten metal and the gaseous medium, having added to it opposite charged direct current electrodes. At the same time they changed the composition of the gaseous medium, introducing into it neutral gases, for example helium, or inert gases such as nitrogen. In some experiments a high vacuum was used as the medium. When a gaseous medium in a neutral helium atmosphere served as the "plus," such impurities as carbon, silicon, sulfur and phosphorus were removed. It was possible to reduce the melts to chemically pure substances. In cases of negative polarity the melts were saturated with additives such as nitrogen. Initial conditions varied in all sorts of combinations for each of the numerous kinds of melts. Finally, statistics which accumulated began to reflect reliably the natural law which was being reproduced.

The new method of actively removing impurities was called electron refining. It is not difficult to control the flow of the process, since the end result is easy to forecast and is determined by the amount and polarity of the voltage. The strength and durability of parts obtained from such metal is increasing substantially.

But will everything be as smooth under industrial conditions as it was at the experimental plant? Many ideas which were excellent in laboratories perished

ingloriously when they were confronted with the harsh reality of a factory shop. It was decided to conduct an industrial test of the method right in a shop.

Under the fault finding gaze of skeptics, a cupola was filled with ingots of the most ordinary pig iron. It was accepted without any hesitation or interruption. The metal was smelted and poured into a reception apparatus, where the scientists watched it. They poked at it a little with their instruments and gas cylinders and saw castings such as the factory workers had not seen even in their most successful smelting efforts.

The new method of processing casting melts makes it possible to obtain more durable parts and a more economical expenditure of metal.

Metal quality is becoming the main way to save metal and further develop metallurgy. For electron refining here this is still to come.

COPYRIGHT: "Znaniye-sila", 1985

9069
CSO: 1842/130

UDC 669.15'26-194:669.786:621.785.78

AGING OF Cr25 HIGH-CHROMIUM STEEL WITH VARIOUS NITROGEN CONCENTRATIONS IN SOLID SOLUTION AT 475°C

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 12 Feb 85) pp 1197-1201

[Article by I. S. Golovin, V. I. Sarrak, S. O. Suvorova and M. I. Chevakina, Institute of Metals Science and Metal Physics, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin]

[Abstract] Aging of high-chromium steel at 475°C was studied, for a determination of the embrittlement mechanism. Specimens of Cr25 steel (24.3% Cr, 0.007% C, 0.033 wt.% N_2) with 0.0034% N_2+C corresponding to full solubility of both interstitial impurity elements were heat treated by heating to 1250°C under vacuum + holding (aging) at that temperature for 30 min + water quenching. Other specimens with only 0.002% N_2+C corresponding to minimum concentration of both impurity elements were water quenched from 650°C or water quenched from 1050°C to 850°C, then held (aged) at 525°C, 500°C, 475°C and 450°C for periods varying from 5 min to 100 h and finally water cooled. Internal friction in specimens 0.8 mm in diameter and its temperature dependence were measured with a relaxator consisting of an inverted torsion pendulum and oscillating at a frequency of approximately 1 Hz in a constant magnetic field of 24 kA/m intensity. Mechanical properties of specimens 3 mm in diameter were measured in an Instron tensile testing machine at a deformation rate of 0.025 s^{-1}, with a Vickers hardness tester, and with a MK-30A impact tester on notched specimens at the ductile--brittle transition temperature of 250°C. Structural examination was done under a Neofot-21 microscope. The dependence of these mechanical properties on the aging time at 475°, after quenching from various temperatures, indicates that "475°C embrittlement" proceeds in two stages. Breakup of the solid solution oversaturated with interstitial impurity elements occurs in the first stage, unless they have been combined into carbonitrides, possibly already accompanied by segregation of iron and chromium. Segregation of iron and chromium characterizes the second stage, in which breakup of the solid solution slows down. References 11: 8 Russian, 3 Western.

2415/12955
CSO: 1842/142

UDC 669.018.25:620.187.5

TITANIUM CARBIDE PRODUCTION FROM OFF-GRADE CHIPS

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 57-59

[Article by S. S. Kiparisov, Yu. V. Levinskiy, O. V. Padalko, A. P. Petrov and I. P. Deulina]

[Abstract] Improvements were made in the production of powdered titanium carbide from off-grade chips resulting from the processing of titanium alloys. A two-stage approach was taken to carbide formation, which can be conducted either in an atmosphere of hydrogen or in vacuo with a residual pressure of 1-10 Pa. The latter process yields high quality titanium carbide while the former is more cost effective. In order to minimize the free carbon in the product, the first stage uses a Ti to C charge that is greater than the stoichiometric equivalent. After regrinding of the product obtained in the first stage recharging with C is employed in the second stage to bring the ratio to stoichiometric proportions. The final product is represented by nonstoichiometric ($TiC_{0.5}$ to $TiC_{0.8}$) titanium carbide with less than 0.2% free C, at a cost of ca. 2-2.5 rubles/kg. References 8: all Russian.

12172/12955
CSO: 1842/146

UDC 621.771.25

STUDY OF RESISTANCE TO DEFORMATION OF BEARING STEEL DURING HOT SHAPING

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 86 (manuscript received 4 Oct 84) pp 85-88

[Article by V. T. Zhadan, V. A. Yatsenko, P. M. Gerashchenko and I. L. Shturgunov, Ukrainian Scientific Research Institute for Special Steels]

[Abstract] Earlier studies of the deformation resistance of bearing steel during hot rolling, did not consider the effect of the residual hardening of the metal during inter-deformation pauses. Using hot torsim and failure tests a study was made in the present article of the effect of the temperature and degree and rate of deformation on deformation resistance taking into account the structural changes occuring in the metal when heated before shaping as well as the dependence of the degree of loss of strength of ShKh 15 steel on the indicated parameters in the inter-deformation pauses. The investigations were performed on specimens 6 mm in diameter and a 30 mm working length made from a hot-rolled 19 mm diameter steel bar. Tension tests were performed on a plastometer over a temperature range of 700-1200°C, at rates of 10-50°C^{-1} and degrees of deformation of 5-40 percent. The loss of strength of the steel was studied during torsion of the specimens on a "Seteram" plastometer at temperatures of 800-1100°C, rate of deformation 6.7c^{-1} and degrees of deformation of 10-50 percent. To take account of the influence of structural changes in the metal during heating before shaping on deformation resistance, the specimens were heated to 1130-1150°C, held for 5-20 min, cooled to the testing temperature and deformed. For comparison some specimens were heated to the testing temperature, held for 5-15 min and deformed. The test results are given. They established the dependence of deformation resistance on the temperature and rate and degree of deformation taking into account the structural changes in the metal which occur when it is heated before deformation as well the dependence which permits calculation of the residual yield stress in the interdeformation pause. The data obtained make it possible to determine the energy parameters more precisely when rolling ShKh15 steel in continuous and semi-continuous with mills and thus to develop more precise hot deformation modes. References 5: all Russian.

12131/12955
CSO: 1842/155

UDC 539.26:539.213:669.15

EFFECT OF ANNEALING ON STRUCTURE OF CORROSION-RESISTANT AMORPHOUS ALLOY $Fe_{73}Cr_{10}B_{17}$

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 1, Jan 86 (manuscript received 8 Jun 84) pp 115-120

[Article by Yu. A. Pustov, Yu. V. Baldokhin and N. I. Isayev, Moscow Steel and Alloys Institute]

[Abstract] The question of the reason for changes in the physical and chemical properties of amorphous alloys after low temperature annealing has not been adequately studied. The present article reports on a nuclear gamma-resonance spectroscopic study of the processes of structural relaxation in the corrosion resistant alloy $Fe_{73}Cr_{10}B_{17}$, subjected to isothermal annealing over the range of 473-623 K. It was shown that these processes brought increased pitting and changes in electrochemical characteristics. Test samples were about 36 microns in thickness and up to 15mm wide. Analysis showed that spectra corresponding to the initial and annealed state of the amorphous $Fe_{73}Cr_{10}B_{17}$ alloy contained three component phases (the spectrum of the amorphous matrix, a spectrum corresponding to the presence in the amorphous alloy of regions enriched by chromium atoms and a spectrum corresponding to the regions enriched by boron atoms) the ratio between which changes as a result of annealing. Electrochemical behavior was studied (after first annealing at 573 K for .25 - 50 hours) in acid or alkaline solutions. Analysis of the entire study's results give grounds for believing that structural relaxation during the low-temperature annealing of Fe-Cr-B alloys is characterized by: redistribution of boron atoms leading to a change in the composition or number of regions enriched by boron; enrichment of the surface of the boron atom as a result of their high chemical activity and the diffusion decomposition of the solid solution which causes a worsening of the passivation characteristics due to an increase in the presence of defects in the oxide film that is formed; delamination of the system. The increase in the chromium content in the surface layers contribute to an increase in corrosion resistance. References 15: 10 Russian, 5 Western.

12131/12955
CSO: 1842/155

DISK SAW CUTS LARGE STEEL BLANKS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article by M. Dmitruk: "Through Metal Like Through Butter"]

[Text] It sometimes happens that, following a string of associations, your memory takes you so far away that it's simply surprising. Why, in the All-Union Scientific Research, Planning and Design Institute for Metallurgical Machine-Building's experimental shop, did I suddenly remember the taiga, sparkling in the sunlight. At one logging-lumbering enterprise I saw lumberjacks lightly equipped with gasoline-powered saws cutting trunks you couldn't put your arms around.

Here, however, there wasn't one piece of wood, just a single "log" of the strongest steel, a half meter in diameter. The saw was a huge disk almost twice as tall as a man. The machine inspires respect, but you still think, "It won't be that easy to handle such a log."

"Was it by chance that you didn't think of an ax?" asked N. Krylov, head of the Rolled Stock Heat-Treating and Cutting Department, with whom I shared my thoughts. "No? Just as well. By the way, we'll come back to this simple tool. But now, let's have a look."

I confess -- at first, I missed the "starry twinkle" of the unique machining process. And no wonder, it's not a "Druzhba" gasoline saw. The disk, furiously spinning at a high speed cut into the blank and cut through literally in a fraction of a second. It even looked as if it had jumped past it. But no, rumbling on rolls, two halves of the steel column rolled out of the machine.

Running ahead, I will say that only the rotary saw created by Soviet scientists could do this. Large-diameter blanks are too difficult for sliding-frame and rocking-type saws used thus far. Their disk, inserted 30 cm deep, heat intensely from friction. The metal to be cut begins to melt and sticks to the tool. Once they have softened, the teeth can no longer gnaw into the steel, the disk does not cut, but presses it. Loads increase sharply, an emergency arises -- the assembly has to be shut off immediately.

Scientists experimented, calculated, and plotted graphs, but couldn't come up with anything sensible. Experiments led to a dead end, from which there was apparently no way out. And, you see, there were no beginners working in the collective; it was headed by an experienced researcher, N. Krylov, doctor of technical sciences and winner of Lenin and State Prizes.

"Now it's time to talk about the ax," smiled Nikolay Ivanovich. Having lost all hope, I suddenly remembered an episode somehow unrelated to our work. The rolling mill operator is hitting a red-hot steel bar -- with an ordinary ax. Yes, he is cutting alloyed steel as thick as a finger, literally like aspen twigs.

What if we were to make a huge mechanical ax which would chop a large, still not cooled blank? Let me say immediately that the scientists were unable to implement this idea. Nevertheless, it helped them avoid stereotyped thinking and inspired them to begin new experiments.

Why does a spinning disk necessarily have to ride back and forth on slides or a rocker like in ordinary designs? Isn't it better to make it move continuously in a circle, like a planet around the Sun? Then it wouldn't have to stop and lose energy in changing direction. Its speed will increase continuously due to energy from flywheels building up speed. And during cutting, the disk descends on the blank with enormous force. Calculations have shown that, with a disk about 3 m in diameter and flywheels weighing several tons, a half-meter ingot can be cut in a fraction of a second. But can the saw teeth withstand the unbelievable load?

Abroad, they already tried to make a disk spin several times faster than normal, but, as a result, they only spoiled expensive equipment. In scientific journals it was argued that it is impossible to work at high speeds. And suddenly, Soviet scientists increased both disk speed and metal feed to each tooth -- a hundredfold all at once! A gamble? Not at all.

They showed me a curious graph made up as if it were two halves. While saw teeth scrape only hundredths of a millimeter in one pass, plastic rupture of the metal occurs. The curve for loads on the tool ascends if process speed increases. In its time, this principle caused many to stray from the right path, encouraging them to halt experiments.

At the All-Union Scientific Research, Planning and Design Institute for Metallurgical Machine-Building, they haven't given up -- and they found the second half of the curve. Researchers have determined that, if speed increases dozens of times and each tooth removes a chip even a millimeter thick, the line on the chart will descend, and loads decrease. At this rate ordinary metal cutting begins, just as, for example, on a miller, and the cutting surface is smooth.

12809/12955
CSO: 1842/163

UDC 621.318.1

DIAMOND GRINDING OF PERMANENT-MAGNET ALLOYS IN ELECTRIC FIELD

Kiev SVERKHTVERDYYE MATERIALY in Russian No 6, Nov-Dec 85
(manuscript received 24 Oct 84) pp 60-64

[Article by A. M. Dolgikh, Saratov]

[Abstract] Electrochemical diamond grinding of the permanent-magnet alloy $SmCo_5$ is analyzed and evaluated, a major consideration being that attainment of a flawless surface requires minimum heat generation within the cutting zone. Bipolar plane face grinding was experimentally done with a special tool consisting of a disk with two electrodes insulated from it, one around the inside edge and one around the outside edge of an annular diamond layer symmetric with respect to the disk axis. Grinding was done with three electrolytical lubricant-collant fluids: 1.) 2.5% KNO_3+ 0.3% $NaNO_2$+ 2% Na_2CO_3+ 2% Ukrinol-1 emulsene; 2.) 10% $NaNo_3$+ 2% Na_2CO_3+ 1% $NaNO_2$+ 3% $C_3H_8O_3$; 3.) 2.5% $NaNO_3$+ 2% Na_2SO_4+ 0.5% $NaNO_2$. The machining rate and the diamond wear with each fluid were measured under an increasing voltage across the electrodes. Both were found to depend linearly on the voltage, the machining rate to increase and the diamond wear to decrease with increasing voltage. Fluid 1. was, moreover, found to be most efficient in both regards. References 9: all Russian.

2415/12955
CSO: 1842/138

UDC 669.71'74:538.221:53.091

DEPENDENCE OF MAGNETIC ORIENTATION IN Mn-Al-C ALLOYS ON STRAINED STATE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 25 Jan 85) pp 1171-1176

[Article by A. V. Shangurov, Ye. I. Teytel, A. Ye. Yermakov and M. A. Uymin, Metal Physics Institute, Ural Science Center, USSR Academy of Sciences]

[Abstract] Hot forging of an Mn-Al-C alloy and the resulting magnetic properties are analyzed for the purpose of optimization. Ingots of such an alloy (68.5% Mn+ 30.2% Al+ 0.75% Ni+ 0.55% C) were cut by the electric-spark technique into hollow cylinders 9 mm in diameter and 5 mm high with the wall thickness varying over the 0.5-3 mm range. These specimens were heat treated for attainment of the optimum τ - phase structure, by homogenization + oil quenching + tempering at 500°C for 1 h, followed by isothermal forging at temperatures from 500°C to 750°C in a UME-10TM testing machine at a rate of 1 mm/min inside an undeformable closed cylindrical yoke made of a heat-resistant alloy. Demagnetization curves (backsides of hysteresis loops) and energy product were measured at successive levels of axial shrinkage strain in three mutually perpendicular directions. These data reveal a preferred orientation of the tetragonal axes of easy magnetization, which tend to align themselves radially as the deformation process continues. An analysis of this process, in accordance with the theory of plastic flow and on the basis of applicable equations of motion for an incompressible material, reveals that the maximum tensile strain is radial and thus coincides with the axes of easy magnetization. The tensile strain rate and thus also the level of shear strain buildup increases from the outside lateral surface toward the inside one, with the total strain difference increasing as the forging process continues. The magnetic properties of an Mn-Al-C specimen improve correspondingly from the periphery toward the center. It appears feasible to optimize the heat treatment as well as the chemical composition of the alloy for production of ring and disk magnets with distinct radial orientation, coercive force of 240 kA/m, and maximum energy product of 16-20 kJ/m^3. References 7: 2 Russian, 5 Western.

2415/12955
CSO: 1842/142

UDC 669.15'24:548.313.3:538.245:53.091

MAGNETIC ANISOTROPY AND FERROMAGNETIC RESONANCE IN DEFORMED Ni_3Fe SINGLE CRYSTALS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 60, No 6, Dec 85 (manuscript received 12 Feb 85) pp 1229-1231

[Article by Ye. F. Kondratyev, A. M. Medikova, L. A. Medikov and A. V. Pets, Kaliningrad State University; Kuybyshev Polytechnic Institute imeni V. V. Kuybyshev]

[Abstract] Ferromagnetic resonance in Ni_3Fe single crystals and anisotropy of the resonance field in their (110)-plane were measured after plastic deformation. Single crystals for this study had been grown by the Bridgeman method, using 99.99% pure nickel and 99.98% pure iron. Plate specimens of two sizes, 30x9 mm^2 and 3x0.75 mm^2, were cut from these single crystals by the electric-spark method with the longer sides in the $[1\bar{1}0]$ or $[\bar{1}11]$ direction. Some specimens were annealed at 1100°C for 3 h in a hydrogen atmosphere and left in the disordered state. The rest was annealed into the ordered state with an almost unity long-range order by heating to 1100°C, holding at that temperature for 3 h, then cooling to 550°C in 15 h, to 350°C in 240 h, and to room temperature with the furnace. The results of measurements of ferromagnetic resonance at 9400 MHz in a rectangular reflection-type H_{103} resonator and of the uniaxial anisotropy constant by the method of twisting moments in magnetic fields of $(4\text{-}7.2)\cdot10^5$ A/m intensity agree closely with the magnetostatic theory of induced anisotropy and yield valuable data on the dislocation structure developing in ordered single crystals during their plastic deformation. The authors thank A. S. Yermolenko for assisting in measurement of the anisotropy constant. References 11: 9 Russian, 2 Western.

2415/12955
CSO: 1842/142

UDC 621.771.25

ROLLING MOLYBDENUM RODS WITH MULTISIDED REDUCTION

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 69-72

[Article by L. A. Barkov]

[Abstract] A description is provided of pilot-plant rolling mill installations at the Chelyabinsk Polytechnical Institute for the production of molybdenum rods with three- and four-sided reduction, in order to obviate the need for the more expensive forging technology. A series of mills (MK-300, MKU-200, MK-330, MK-210) were designed and tested, demonstrating that multisided rolling decreased the gas saturation of the metal and reduced surface and internal defects and flaws several fold. An added benefit is the decrease in manual operations that have to be performed and the reduced noise level, factors which significantly improve working conditions. In the final analysis, three-sided reduction was a less efficient process than four-sided reduction. References 15: all Russian.

12172/12955
CSO: 1842/146

UDC 621.762:621.984.8:519.2

STUDY OF ISOTHERMAL PRESSING OF NICKEL-BASED POWDER ALLOY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIY in Russian No 1, Jan 86 (manuscript received 25 Feb 85) pp 88-92

[Article by V. O. Guk, N. P. Reutova, Yu. F. Luzin, L. N. Petrov, T. N. Berdyayeva and A. L. Meandrov, Central Scientific Research Institute for Ferrous Metallurgy]

[Abstract] Research into low-waste shaping methods for powder metallurgy takes on growing importance as that branch of industry expands. The present article reports on a study of a nickel-based powder alloy to determine the influence of temperature, stamping force and time of deformation. A vacuum diffusion welding installation with a furnace working vacuum of $1.3\ 10^{-2}$ Pa, maximum temperature of 1500°C, punch motion rate of 0.2 mm/s, and nominal voltage of 12V (along with other parameters) was used. The powder alloy Mo-Zr B_2 was used in the manufacture of the closed die which shaped the porous blanks. The authors sought to determine optimum shaping conditions and to establish the quantitative relationship between the factors being studied and the optimization parameters. Experimental data and mathematical modeling indicated that quality stampings at P 50.5 MPa could be produced at 1200°C in a process of 45-minute duration.

12131/12955
CSO: 1842/155

UDC 546.681.3'191.1

PROTECTIVE DIELECTRIC COATINGS FOR GaAs SUBJECTED TO HEAT TREATMENT

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 1, Jan 86
(manuscript received 2 Apr 84) pp 147-149

[Article by V. M. Ardyshev, A. P. Mamontov, V. G. Melev and I. D. Filimonova]

[Abstract] SiO_2 and Si_3N_4 films were formed on Te-doped epitaxial GaAs films to test their effectiveness in preventing dissociation of GaAs during heat treatment (750 or 850°C for 3 h in vacuo or in 0.15 MPa As atmosphere). Analysis of photoluminescent spectra induced by laser LG-75-1 showed Si_3N_4 to be a superior coating in protecting GaAs films from thermal destruction via-a-vis SiO_2. In addition, coatings applied by cathodal atomization were superior to those obtained by chemical deposition. References 8: 5 Russian, 3 Western.

12172/12955
CSO: 1842/164

UDC 621.785.6.001.57

MATHEMATICAL MODELING OF STEEL QUENCHING PROCESS WITH EFFECT OF STRESSES ON STRUCTURAL TRANSFORMATIONS TAKEN INTO ACCOUNT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 2-6

[Article by V. Ye. Loshkarev, Central Scientific-Research and Planning-Design Boiler and Turbine Institute imeni I. I. Polzunov, Scientific-Production Association]

[Abstract] A mathematical model is constructed which describes quenching of steel and takes into account the effect of stresses on the structural transformations during this process. The thermokinetic diagram characterizing the breakup of subcooled austenite is approximated by a sequence of temperature intervals within which martensite transformation occurs and by two exponential equations which describe pearlite transformation and bainite transformation respectively. A multiplier is included, to account for the highest possible bainite content in alloy steels not surpassable throughout the entire process of quenching from a given temperature in a given state of stress. Calculations based on this model have been programmed in FORTRAN for a YeS 1052 computer, the algorithms in the STRESS program having been written specifically for cylindrical steel objects. References 11: 6 Russian, 5 Western (1 in Russian translation).

2415/12955
CSO: 1842/137

UDC 621.78:621.73.073

OPTIMIZATION OF HEAT TREATMENT OF DIES FOR HOT DEFORMATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 23-26

[Article by M. S. Kenis, Kuybyshev Polytechnic Institute]

[Abstract] Heat treatment of dies made of 4Cr3WMoV steel for hot deformation was studied in an experiment in which 330 such dies were heat treated in 22 different ways (15 dies in any one way). One half of the dies had been forged with fiber meshing, the other half without. Ingots were heated in a gas furnace to 1130-1150°C and held there for 20-30 min. Microstructural examination and hardness tests after each heat treatment and subsequent nitriding indicate that the most cost effective heat treatment of dies forged without fiber meshing is: oil hardening at 700°C + annealing at 680°C for 3 h + quenching from 1070-1080°C + tempering at 600°C for 2 h to a 50-54 HRC hardness. When forging with fiber meshing is necessary, then the optimum heat treatment includes oil cooling after forging, quenching from 1140°C after annealing, and tempering twice at 600°C for 1 h to a 50-54 HRC hardness. References 2: both Russian.

2415/12955
CSO: 1842/137

UDC 621.78:669.14.018.29

HEAT TREATMENT OF STRUCTURAL ALLOY STEELS FOR BETTER MALLEABILITY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 27-31

[Article by V. A. Belov, V. A. Golovin and A. M. Sokolov, Moscow Automotive Mechanics Institute and Scientific Research Institute of the Technology of the Automobile Industry]

[Abstract] Heat treatment of the two structural alloy steels 40Cr and 12CrNi3A was studied, for the purpose of establishing a one-to-one relation between their structure and their malleability. Both steels require heat treatment, since neither of them in the cast state is structurally adequate for drop forging. The heat treatment necessary for optimum malleability has been established on 40 ingots of the 40Cr steel and 50 ingots of the 12CrNi3A steel, namely spheroidization in furnace and then in air after oil hardening at Ac_3+ (150-200°C) temperature and isothermal soaking at Ac_3-20°C temperature so as to produce a pearlite structure with 1 μm cementite globules uniformly distributed in the ferrite matrix in 40Cr steel and a ferrite+ pearlite structure with 0.040 mm pure homogeneous ferrite grains in the 12CrNi3A steel.

2415/12955
CSO: 1842/137

UDC 621.78:620.17:669.14.018.29

DEPENDENCE OF AUSTENITE BREAKUP KINETICS AND MECHANICAL PROPERTIES ON CONDITIONS OF AUSTENITIZATION OF Cr-Ni-Mo STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 31-33

[Article by Yu. M. Balychev, M. V. Khlestov, V. F. Voznyakov and Z. V. Frolova, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin, Zhdanov Department, and Zhdanov Metallurgical Institute]

[Abstract] Isothermal transformation of austenite in 30CrNi4Mo steel was studied by the magnetometric method on an anisometer with special measuring head, after 12x8x2 mm^3 large specimens had been austenitized in a tubular furnace at 1050°C and then held at 700°C for 20 min. Some specimens had been first cooled to 950°C and hot rolled to 20% elongation. An analysis of the transformation kinetics within the intercritical temperature range reveals that austenitization contributes to a faster breakup of subcooled austenite within both the pearlite and bainite ranges. Isothermal hardening within that temperature range and subsequent water cooling were found to produce a homogeneous highly disperse structure with excellent mechanical properties, only slightly improved by ameliorating heat treatment (quenching from 900°C + soaking at 700°C + oil cooling + tempering at 650°C) before water cooling. P. P. Karpenko participated in the study. References 4: all Russian.

2415/12955
CSO: 1842/137

UDC 621.785.5:621.785.784.4(088.8)

DIFFUSION-CONTROLLED CHROME-PLATING BY DEPOSITION OF PLASMA COAT ON STEEL SURFACE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 1, Jan 86 pp 34-36

[Article by I. Ya. Ryazantsev, I. A. Goncharenko, N. G. Filatov, V. V. Kazanskiy and V. T. Seroshtan, Tula Polytechnic Institute and Tulachermet Scientific-Production Association]

[Abstract] A study of diffusion-controlled chromium plating was made, with deposition of a plasma coat on the steel surface and subsequent annealing in an oil-flame furnace included in the process. Specimens of commercial St 3 carbon steel (0.18% C) were cleaned with benzine and a blast of metal shot, then heated with a plasma jet or a gas-flame burner (natural gas + oxygen) to 150-250°C. After a 10-20 s pause, chromium powder of the 50-80 μm size fraction was deposited with a UPU-3D plasmotron delivering 30-40 l/min of N_2+ Ar plasma at a voltage of 65 V and a current of 325 A. The coating thickness was regulated over the 0.2-1.5 mm range. Specimens with chromium plating were annealed in an oil-flame furnace at 1200°C for 0.5-2-4 h and then air cooled. Metallographic examination under an MIM-8 microscope and with an MAR-1 microanalyzer revealed no clear dependence of the diffusion layer thickness and of the chromium concentration profile across the diffusion layer on the annealing time and on the chromium plating thickness. Microhardness measurement with a PMT-3 tester revealed an intricate variation of microhardness, with a maximum H= 450-550 at a distance of 40 μm under the surface and a minimum H= 120 within the carbon-depletion zone. Specimens with chromium plating were hot rolled and hot forged. Then cylindrical specimens 320 mm long and 14 mm in diameter, after being water quenched from 900°C, were life tested along with specimens without chromium plating for corrosion cracking in saturated H S solution of acetic acid (pH= 2.7) under mechanical tension to a level of 80% or 90% of ultimate strength. The results indicate hot forming of steel blanks with diffusion-controlled chromium plating can be combined with their annealing, which is technologically advantageous. Such a chromium plating, which builds up during equilibrium phase transformations at the annealing temperature, imparts to semiproducts as well as to finished products a high corrosion resistance after appreciable plastic deformation. G. V. Drozdova participated in the study. References 2: both Russian.

2415/12955
CSO: 1842/137

UDC 620.179

NONDESTRUCTIVE INSPECTIONS OF MULTILAYER TUBES DURING MANUFACTURING PROCESS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 10, Oct 85 (manuscript received 14 Aug 84, in final version 11 Mar 85) pp 73-78

[Article by V. A. Troitskiy, S. M. Biletskiy, A. A. Trushchenko, A. A. Rybakov, V. T. Bobrov, Ye. V. Morozov, Yu. K. Bondarenko and Yu. N. Posypayko, Electric Welding Institute imeni Ye. O. Paton, UkSSR Academy of Sciences]

[Abstract] Multilayer tubes for high-pressure gas piping are designed to withstand pressures up to 12 MPa, which requires a special manufacturing process. Metal strip is unreeled and straightened, then dried and cut, for winding into seven shell segments 1500-1650 mm long each. The two outermost segments are solid, the five segments in between have multilayer walls consisting of 4-6 turns of 5.2-5.4 mm thick strip. Assembly and joining of segments by welding under tension are followed by hydrostatic testing of the annular seams and trimming of the ends before stocking of the tubes in the warehouse. A system of nondestructive inspection has been devised for quality control through all stages of this manufacturing process. It includes x-ray analysis over television for inspection of inside as well as outside surfaces and ultrasonic as well as vacuum-bubble flaw detection. This inspection system, together with the appropriate transportation and switching, has been automated. The NK100 automatic inspection facility, developed at the Electric Welding Institute, performs all scanning and marks locations for transducers, feeds and removes contact fluid, manipulates the transducers, records inspection results, and marks defective spots. This automatic inspection facility is operating at the Khartsyzsk Tube Manufacturing Plant, and also at the Vyksa Metallurgical Plant together with UD 78BM automatic manufacturing equipment developed by the Volna Production Association in Kishinev. References 13: all Russian.

2415/12955
CSO: 1842/104

UDC 621.791.052:624.017.27:620.178.3:620.193.27

RESISTANCE OF TUBULAR WELDED JOINTS TO FATIGUE FRACTURE IN SEA WATER

Kiev AVTOMATICHESKAYA SVARKA in Russian No 12, Dec 85 (manuscript received 25 Feb 85, in final version 20 May 85) pp 10-12

[Article by E. F. Garf, candidate of technical sciences, A. Ye. Litvinenko, engineer and V. V. Zaytsev, engineer, Institute of Electric Welding imeni Ye. O. Paton, UkSSR Academy of Sciences; O. I. Steklov, doctor of technical sciences and A. Kh. Smirnov, engineer, Moscow Petrochemical and Gas Industry Institute imeni I. M. Gubkin]

[Abstract] For a desgin and performance analysis of stationary offshore platforms carrying oil drill rigs, tubular welded joints of structural steels were tested in an electrolyte of 3-3.5% aqueous NaCl solution simulating natural sea water. An assortment of steels with 0.12-0.26% C, 0.01-0.03% P, 0.004-0.02% S, 0.5-0.6% Mn, 0.1-0.87% Cr, 0.01-0.07% Ni, 0.1-0.17% Cu, 0.009-0.03% Al, 0.002% Ti, 0.039-0.05% Nb, >0.03% Mo, >0.007% V was evaluated for fatigue resistance of their tubular welded T-joints under loads swinging over ranges of 9.52-14.0 kN at a frequency of 12.5 Hz with a symmetry factor of R= -1 in 84 series of tests. With the four basic mechanical properties (ultimate tensile strength σ_u= 400-570 MPa, 0.2% Yield point σ_y= 250-420 MPa, percentage elongation δ = 30-42%, percentage area reduction ψ = 53-60%) as reference, this evaluation consisted of statistical data sampling and subsequent mathematical data processing with the use of interpolations. The probability of crack initiation could be assumed to depend on the local conditions within the zone of eventual fracture, assuming an analogy of interaction mechanisms and kinetics under test conditions to those under natural conditions. On this basis and on the basis of 20-310 h testing time, the duration of a test depending on the load level, the results of the evaluation indicate that sea water reduces the life of such joints to one half below the design level, with their fatigue curves representing 50% probability of fracture sloping down as far as the base of $2 \cdot 10^8$ cycles. References 10: 3 Russian, 7 Western.

2415/12955
CSO: 1842/140

UDC 621.791.72:621.373.862.001

DEPENDENCE OF EFFICIENCY OF LASER-BEAM WELDING ON APERTURE ANGLE AND ABERRATIONS OF FOCUSING SYSTEM

Kiev AVTOMATICHESKAYA SVARKA in Russian No 12, Dec 85 (manuscript received 11 Feb 85) pp 24-26

[Article by V. A. Tochilkin, engineer and Yu. Ya. Usanov, engineer, Kuzan]

[Abstract] An experimental study of laser-beam welding was made, for the purpose of determining the dependence of its efficiency on the geometrical and energy parameters of the focusing system. Tests were performed with an LSU-5 5kW laser facility including an unstable resonator with M= 1.5 magnification and three different focusing systems ($2\alpha_K$ - aperture angle of focused laser beam, d- diameter of focal spot, d_D- diffraction diameter of focal spot, d_A- abberration angle of focal spot): 1) $2\alpha_K = 6^\circ$, d= 0.34 mm, d_D= 0.2 mm, d_A= 0.28 mm; 2) $2\alpha = 3^\circ$, d= 0.41 mm, d_D= 0.4 mm, d_A= 0.08 mm; 3) $2\alpha = 6^\circ$, d= 0.24 mm, d_D= 0.2 mm, d_A= 0.13 mm. Specimens of 12Cr18Ni10Ti stainless steel were welded, $2\alpha_K = 6^\circ$ being considered the optimum aperture angle of a laser beam for joining 5-10 mm thick parts. The experimental data have been evaluated in accordance with theoretical relations describing the dependence of the depth of fusion and thus of the efficiency of welding action on the laser beam and focusing system characteristics. Residual spherical aberrations were calculated on a YeS-1033 computer, with mathematical simulation of the laser beam by an array of elementary beams according to the laws of geometrical optics and assuming that $d_A = k_A \alpha_K^2$ while $d_D = k / \alpha_K$. The results of this evaluation, confirmed by macrostructural examination of weldments, indicate that residual spherical aberrations decrease the optimum aperture angle of the focused laser beam. Accordingly, the optimum aperture angle of the focusing systems 1 and 3 are respectively 4.5° and 4° rather than 6°, while the aperture angle of the focusing system 2 characterized by negligible aberrations remains 3°. References 8: 7 Russian, 1 Western (in Russian translation).

2415/12955
CSO: 1842/140

UDC 621.791.75:629.12.011.7

EXPERIENCE WITH USE OF MULTIHEAD WELDING MACHINES FOR CONSTRUCTION OF MEDIUM-TONNAGE SHIPS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 12, Dec 85 (manuscript received 27 Dec 84, in final version 18 Jun 85) pp 32-36

[Article by A. I. Chvertko, doctor of technical sciences, V. A. Bogdanovskiy, engineer, V. Ya. Dubovetskiy, engineer, V.K. Zyaakhor, engineer and V. I. Avramenko, engineer, Institute of Electric Welding imeni Ye. O. Paton, UkSSR Academy of Sciences; Yu. G. Mosenkis, candidate of technical sciences, Leninskaya Kuznitsa Plant, Kiev]

[Abstract] Multihead welding machines are used in shipbuilding for joining tier or deck sections by unilateral continuous angle welds, joining T-bar stiffeners by bilateral angle welds, joining hull stringers and hoops at their intersections by vertical angle welds, and butt welding of panels. At the Leninskaya Kuznitsa shipbuilding plant these operations are done by welding machines designed to produce 2-4 angle weld simultaneously or, in the case of panels, successively with welding heads moving "in tandem" at a certain distance from one another. The right-angle welds joining stringers and hoops have a 5-8 mm wide cathetus and are produced with electrodes correspondingly 1.6-2.0 mm in diameter. The right-angle seams joining T-bars have a 3-6 mm wide cathetus and are produced with electrodes 1.2 mm in diameter. The welding rate is 30-38 m/h horizontally or vertically downward and 5-8 m/h vertically upward. The welding machines used at the Leninskaya Kuznitsa for construction of medium-tonnage ships include general-purpose automatic 2-head welders for T-bars, the special-purpose OB-1494 automatic 4-head machine for electric-arc pulse welding vertically just as in construction of large-tonnage ships, several special-purpose AD-1689 automatic machines moving on trucks for electric-arc welding under a gaseous shield (83% CO_2+ 17% O_2) just as in construction of small-tonnage ships but simultaneously rather than "in tandem", and the special-purpose AD-106 automatic machine for electric-arc welding under flux horizontally. All these welding machines operate at a voltage of 27-34 V with a current of 250-350 A, depending on the particular operation. The economic effect of using these automatic welding machines instead of manual ones ranges, on the basis of higher productivity, from 3,000 to 15,000 rubles annually depending on the particular operation.

2415/12955
CSO: 1842/140

UDC 621.791.754'293.053.09:656.612:621.797

ARGON-ARC TREATMENT OF WELDED JOINTS DURING OVERHAUL OF SHIP HULLS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 12, Dec 85 (manuscript received 25 Jan 85) pp 42-44

[Article by K. Ye. Khatskin, engineer, Riga Shiprepair Plant and G. A. Ivashchenko, candidate of technical sciences, Institute of Electric Welding imeni Ye. O. Paton, UkSSR Academy of Sciences]

[Abstract] Argon-arc flash welding of welded joints within the zone of transition from weld to base metal has been introduced at the Riga Shiprepair Plant as one of the overhaul operations, this method of reducing stress concentrations and thus extending the life of such joints being preferable to grinding. Its advantages over conventional smoothing of surfaces by abrasion are not only higher productivity and complete access to bulkheads as well as measurability of critical weld dimensions after treatment but also elimination of the health hazard posed by abrasive dust. Argon-arc treatment is done with commercial welding equipment, which includes VL tungsten wire electrodes 5 mm in diameter, operating at a voltage of 16 V with a current of 240-260 A. It also includes a torch with gaseous (argon) shielding and water (antifreeze in winter) cooling. This equipment is capable of flash welding 8-10 mm wide strips at a rate of 8-10 m/h. It is designed and installed in cages so as to fit into the overall overhaul operation, to be compatible with the large size of welded structures and with the need for scaffolding as well as for long cables connecting it to a remote power source. Flash welding is generally done with the torch tilted forward, avoidance of crater formation being the most important requirement. It is also important that the base metal be scale-free so as to ensure no undercutting of the weld during argon-arc treatment. The technology of such a treatment is best illustrated on the rudder of a diesel ship, for the overhaul of which an A-574U semiautomatic welding machine with Sv-08G2S welding rods 1.2 mm in diameter is used. References 2: both Russian.

2415/12955
CSO: 1842/140

UDC 621.791.927.5-2:621.7.044:539.4

EFFECTIVENESS OF SPUTTER TREATMENT FOR HIGHER FATIGUE RESISTANCE OF STRUCTURAL MEMBERS WITH WELDED-ON BUILDUP

Kiev AVTOMATICHESKAYA SVARKA in Russian No 12, Dec 85 (manuscript received 12 Jun 84, in final version 15 Feb 85) pp 45-48

[Article by T. G. Kravtsov, candidate of technical sciences and N. Kh. Solyanik, engineer, Zhdanov; P. P. Mikheyev, candidate of technical sciences, Institute of Electric Welding imeni Ye. O. Paton, UkSSR Academy of Sciences; and A. A. Khrapov, candidate of technical sciences, Krasnyy Oktyabr Metallurgical Plant, Volgograd]

[Abstract] Structural members made of pearlitic steel are built up with austenitic steel welded on electrically, austenitic steel being used as the electrode material. The slag inclusions inevitably forming in the austenitic bead and lowering the wear resistance as well the fatigue resistance are usually removed by heat treatment such as hot rolling or other hardening processes. Sputter treatment as an alternative method of hardening such a buildup was studied in an experiment with two batches of cylindrical specimens 70 mm in diameter. One batch was sputter treated immediately after buildup, the other batch was conventionally heat treated by slow heating to 800°C in 2 h + soaking at 800°C for 1 h + furnace cooling to 400°C in 6 h + complete cooling in air to room temperature. All specimens were tested in alternating cyclic flexure during rotation at 1500 rpm= 25 Hz in air. The test data have been evaluated in the form of stress-life fatigue curves representing 50% probability of fracture, with $1 \cdot 10^7$ cycles as base. Examination under a microscope with various magnifications (x320, x130) revealed distinctions between hot cracks and fatigue cracks. The results indicate that sputter treatment does not increase the fatigue resistance of buildup metal with cracks already initiated by such a treatment, but appreciably increases the fatigue resistance of buildup metal without such cracks. In the case of low-carbon steel such as 08kp sputter treatment raised the fatigue resistance of buildup metal to that of the base metal. References 7: 5 Russian, 2 Western.

2415/12955
CSO: 1842/140

EXTRACTIVE METALLURGY AND MINING

MINE WORKERS AWARDED ORDERS, MEDALS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 6 Mar 86 p 3

[Article: "In the USSR Supreme Soviet Presidium"]

[Text] By an order of the USSR Supreme Soviet Presidium of 5 March 1986, the most outstanding workers of the Pevek Mining and Concentration Combine of the USSR Ministry of Nonferrous Metallurgy's Northeastern Production Gold-Mining Association (Severovostokzoloto) were awarded USSR orders and medals for early completion of tasks under the 11th Five-Year Plan and for fulfillment of socialist obligations.

Bulldozer operator A. I. Popov was decorated with the Order of the October Revolution.

The Order of Labor Red Banner was awarded to 5 persons; the Order of Peoples' Friendship to 2; the Order of the Badge of Honor to 8; a second-degree Order of Labor Glory to 2; a third-degree Order of Labor Glory to 7; the medal "For Labor Heroism" to 12; and the medal "For Labor Distinction" to 13.

12809/12955
CSO: 1842/163

UDC 622.764

ORE ENRICHMENT AT THE KRASNORECHENSK PLANT

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 82-85

[Article by A. A. Golikov and L. M. Agafonova]

[Abstract] A modification was introduced into the flotation process employed at the Krasnorechensk Plant used for ore processing so as to diminish the loss of metal sulfides in the lead concentrate between the first and second stages of tin flotation. During dehydration of the first stage flotation tailings approximately 7% of tin, 8% of lead and 10% of zinc are lost. The proposed modification eliminated concentration by tabling after the first stage of tin flotation, followed by improved flotation conditions for lead and zinc. A further increase in lead recovery can be realized by the use of an entrapment device for finely dispersed casserite. References 5: 4 Russian, 1 Western.

12172/12955
CSO: 1842/146

UDC 622.725

SCALE OF GRADATIONS AND RESOLUTION CHARACTERISTICS OF TUNGSTEN ORES

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 85-88

[Article by V. I. Yermolenko, V. I. Yuryev, V. G. Nesterov, B. I. Berdichevskiy and L. Ye. Krasivina]

[Abstract] A comparative analysis was conducted on three methods for assessing the suitability of tungsten ores for enrichment procedures on the basis of fractional analysis of particle size. Evaluation of the results obtained with samples from two different deposits subjected to the gravitational, roentgenoluminescent and roentgenoradiometric methods demonstrated that the latter technique was most imformative in identifying ores for enrichment. The results indicate that gating tables can be constructed for the particle-size profiles of ores as a basis for estimating suitability for enrichment and WO_3 losses with tailings. References 5: all Russian.

12172/12955
CSO: 1842/146

UDC 622.765:622.3

DEPRESSION OF ARSENOPYRITE IN SELECTION OF GOLD-CONTAINING PRODUCTS

Moscow TSVETNYYE METALLY in Russian No 1, Jan 86 pp 88-90

[Article by D. I. Kogan, S. M. Murchenko and L. I. Antsiferova]

[Abstract] Potassium peroxododisulfate ($K_2S_2O_8$) was tested as a depressant for arsenopyrite in the processing of Au-As ores. In selective flotation potassium peroxodisulfate was more efficient than potassium permanganate when used in a concentration of 1 kg/t after liming (pH 8.5), yielding Au-Cu concentrates with less than 1.8% As. The advantage of potassium peroxodisulfate also lies in the fact that it may activate pyrite and chalcopyrite via interaction with copper sulfate. References 5: all Russian.

12172/12955
CSO: 1842/146

MISCELLANEOUS

NEW TUBULAR STEEL SUPPORTS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Feb 86 p 4

[Article "Reliable Support" under the rubric "Made in the USSR," with the tag line "Selected from material from the Sverdlovsk Center for Scientific Technical Information. Address requests to: 620095, Sverdlovsk, ul. Malysheva, 101 TsNTI"]

[Text] Openwork steel supports are used in shop bays, scaffolds, overpasses, and galleries. Even the finest supports use a great deal of metal, and they need periodic painting, or they rust through. As compared to standard supports, the tubular supports offered by Urals engineers have a simpler design, take one-half the labor to produce, and are simpler to paint.

12809/12955
CSO: 1842/163

- END -